

NEYER, TISEO & HINDO, LTD.

Consulting Engineers and Geologists

REPORT ON SUPPLEMENTAL GEOTECHNICAL INVESTIGATION

PROJECT NO:

88612 AW

DESIGNATION:

Allen Park Clay Mine

Hazardous Waste Disposal Cell

LOCATION:

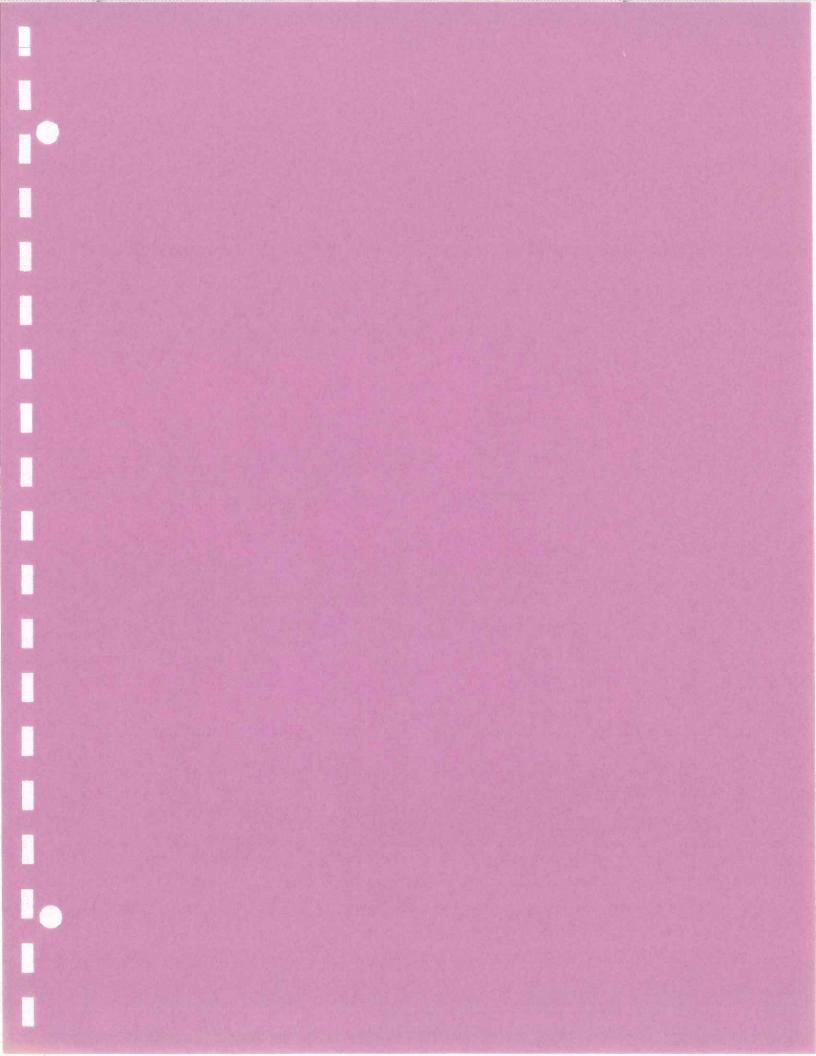
Allen Park, Michigan

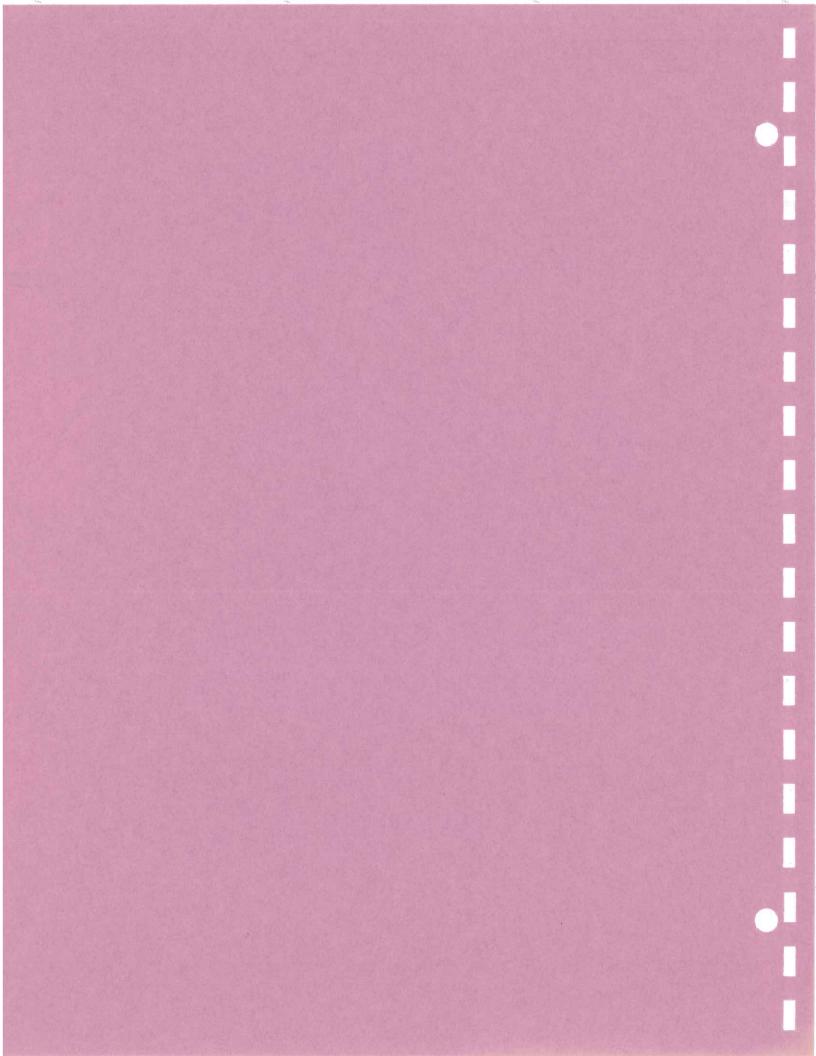
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SUPPLEMENTAL GEOTECHNICAL INVESTIGATION ALLEN PARK CLAY MINE HAZARDOUS WASTE DISPOSAL CELL ALLEN PARK, MICHIGAN

This report presents the results of a supplemental geotechnical investigation and slope stability analysis performed for the proposed Hazardous Waste Disposal Cell at the Allen Park Clay Mine in Allen Park, Michigan. The purpose of this supplemental investigation was to develop additional geotechnical data and to refine the previously performed slope stability analysis. The results of our investigation and subsequent analyses, together with our conclusions are documented herein. Authorization to perform this investigation was given through acceptance of our proposal dated October 18, 1988.

Previous Investigation

As part of the original preparation of the Construction Permit application for the Allen Park Clay Mine for Hazardous Cell II, NTH was retained by Ford to perform a geotechnical investigation. This previous investigation was performed in 1985 and consisted of the drilling of two soil borings, designated TB-1 and TB-2, and the installation of a pneumatic piezometer. The test borings were drilled from the prevailing ground surface at the northwest and southwest corners of the cell. During the drilling operations, a series of undisturbed samples as well as in-place soil strength tests (vane shear) were performed. Laboratory

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testing of selected soil samples was also performed during this original investigation. The results of that investigation were presented in a report prepared by NTH entitled "Liner Engineering Report", dated March, 1988 and revised June 24, 1988.

Based on the results of the in-place soil strength testing and the laboratory soil testing performed for this original investigation, a generalized soil strength profile was developed and a short-term (or undrained) slope stability analysis was performed. Results of this slope stability analysis were included in the Liner Engineering Report.

Copies of the Logs of Test Boring for TB-1 and TB-2 as well as the associated laboratory and field test results developed during this previous investigation are included within this report in Appendix B.

Project Drawings

The Project Drawings entitled Allen Park Clay Mine Landfill-Hazardous Waste Disposal Site - Cell II prepared by Midwest Consulting, Inc. (MCI) were reviewed as part of our work for the supplemental geotechnical investigation. These drawings include cross-sections through the proposed cell showing the existing ground surface as well as the final cell configuration.

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Based on our review of the MCI drawings, the cell floor elevation is presently approximately Elevation 563. The final bottom elevation is planned to be Elevation 567. The existing side slopes are at approximately 2 horizontal: 1 vertical (2:1). The proposed side slopes will be constructed at 4:1 slopes for approximately the lowest 12 feet of the cell, and 2:1 slopes above that. The existing top of slope elevation is approximately Elevation 594. In the final condition after completion of construction, the top of the berm shown on the MCI drawings will range from approximately Elevation 603 to 605.

MCI drawings show fill material in the solid waste management cells located immediately west and east of Cell II. It was reported by Ford personnel that these materials consist of slag sand and fly ash and industrial wastes from the Rouge Steel plant.

Field Investigation

During the period from January 13 through January 20, 1989 three test borings, designated TB-3 through TB-5, were drilled at the locations shown on the Test Boring Location Plan, Plate 1 in Appendix A. As shown on Plate 1, test borings TB-3 and TB-4 were drilled from the prevailing ground surface at the northeast and southeast corners of the cell, and test boring TB-5 was drilled from inside the cell in the northeast corner of the cell. The

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locations of the test borings were chosen by Ford Motor Company in accordance with the scope of work outlined in the proposal for this investigation which was submitted to and verbally approved by the MDNR.

Test borings TB-3 and TB-4 were each drilled to a depth of approximately 90 feet below the ground surface, corresponding to approximately Elevation 505, and test boring TB-5 was drilled to a depth of approximately 58 feet below the ground surface of the cell, also corresponding to approximately Elevation 505. Boring locations and surface elevations were determined by Wayne Disposal Incorporated, (WDI). The coordinates and ground surface elevations at the test boring locations are presented on the Logs of Test Borings.

The test borings were drilled by American Drilling Company under the full-time supervision of a geotechnical engineer with our firm. The test borings were drilled with a truck-mounted rotary drilling rig utilizing 4-inch outside-diameter solid stem augers to a depth of 8.5 feet. Casing was then installed in the borehole and the boring continued utilizing wash rotary techniques.

Soil conditions encountered in the test borings have been evaluated and are presented in the form of Logs of Test Boring, Figures 1 through 3 in Appendix A. In addition, the boring logs

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present information relating to sample data, standard penetration test results, water conditions observed in the borings, personnel involved and other pertinent data. For information and to aid in understanding the data as presented on the boring logs, General Notes defining nomenclature used in soil descriptions are presented in Plate 2. It should be noted that the logs included with this report have been prepared on the basis of laboratory classification and testing as well as field logs of the soils encountered.

For the supplemental study, soil samples were generally obtained at intervals of 5 feet. In general, the sampling procedure consisted of alternating piston samples with in-place strength tests (i.e. vane shear tests). However, a few soil samples were taken by the Standard Penetration Test (SPT) Method (ASTM D-1856), whereby a 2.0-inch outside-diameter split-barrel sampler is driven into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sampler is generally driven three successive 6-inch increments, with the number of blows for each increment being recorded. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N) and is presented graphically on the individual Logs of Test Boring for the samples where Standard Penetration Tests were performed. As added information, the blow counts for each 6-inch increment are also included on the logs where appropriate.

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The primary purpose of the supplemental investigation, however, was to obtain detailed strength data of the subsoils at the site. For this reason, it was necessary to obtain undisturbed samples of the native soil using a hydraulically activated piston tube sampler. The procedure involves pushing a 3-inch outside-diameter thin-walled Shelby tube into the underlying soil and then withdrawing it with the enclosed cylinder of soil. After sampling, the ends of the Shelby tubes were cleaned and sealed with wax. Soil samples obtained in this manner are designated "PS" on the logs.

Vane shear tests were also performed in the soft subsoils at regular intervals. These tests were generally performed at alternate intervals to the piston samples. These tests were performed in accordance with the procedure outlined in ASTM D-2573.

The tests were performed by pushing a tapered vane into the soil a distance of 18-inches below the base of the bore hole. Torque was then applied to the vane until the surrounding soil was sheared. This torque was then measured and converted to a soil shear strength in accordance with ASTM Standards. This shear strength is included in the Vane Shear Reports, Figure Nos. 4 through 20 in Appendix A. The location of the individual vane shear test intervals at each test boring location have also been

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included on the respective test boring logs. It should also be noted that the vane shear strengths have been adjusted in accordance with the procedure outlined in an article entitled "Embankments on Soft Ground", by Laurits Bjerrum as presented in the ASCE Conference on Performance of Earth and Earth Supported Structures, Volume II, June, 1972.

Laboratory Testing

Laboratory testing for this project consisted of the determination of the natural moisture content, in-place dry density, Atterberg limits and unconfined compressive strength of selected samples. The results of these laboratory tests are presented on the Tabulation of Test Data Sheets, Figure Nos. 21 and 22 in Appendix A. The natural moisture content and in-place dry density data shown in Figures 21 and 22 are also presented on the respective Logs of Test Boring.

Consolidated undrained (CU) triaxial tests with pore water pressure measurements were also performed on selected piston samples. These tests were performed in order to develop estimates of both the short and long term strength parameters of the soft clays present at this site. Each sample was initially consolidated to the in-situ overburden pressure, and was then subjected to an applied vertical load. Sample deformation and pore pressure measurements were recorded during the testing. The

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results of these tests were then evaluated, and used to develop both total and effective stress parameters for the subsoils at the site. The results of the triaxial testing have been summarized and are presented on Figure 23 in Appendix A.

Additionally, two consolidation tests were performed to confirm the compressibility characteristics used to estimate settlement of the cell in the initial geotechnical analysis. The results of the consolidation tests are presented on Figure Nos. 24 and 25 in Appendix A, entitled Settlement versus Stress.

Subsoil Conditions

on the basis of the information developed during both the previous and current investigations, it appears that subsoil conditions throughout this site are reasonably uniform. At the present time, a fill deposit consisting of either brown to dark brown silty clay or medium compact brown to black silty sand and slag is present in test borings TB-1 through TB-4 to depths ranging from approximately 8 to 13.6 feet (Elevations 582 to 592). The stratigraphic sequence of the natural soil underlying the fill consists of a relatively thin layer of stiff lacustrine silty clay underlain by four glacial clay deposits. These clay deposits, in order of occurrence, consist of two medium gray silty clay formations, a stiff gray silty clay deposit and a hard gray silt clay to clayey silt locally termed hardpan. Underlying

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the hardpan material, the native bedrock formation is encountered. These layers appear to be generally quite flat in the vicinity of the hazardous waste cell. However, the elevation at which the hardpan layer was encountered at the location of test boring TB-1 suggests a slight dip or anomaly in the top of the hardpan at that location.

Based on the subsurface information obtained in both investigations, the subsurface for the native soil was subdivided into five layers (4 through 8) and they are described below. For ease of reference, the native soil layers have been designated Layer 4 (lacustrine silty clay), Layers 5 and 6 (two medium silty clay layers), Layer 7 (stiff silty clay) and Layer 8 (hardpan). The fill deposits have been designated Layers 1 through 3, and are discussed in a later section of this report.

Design Layer 4 - At the locations of TB-3 and TB-4 a stiff lacustrine deposit is encountered beneath the fill, which extends to depths ranging from approximately 19 to 22 feet below the existing ground surface (Elevations 578 to 572). The test boring logs for of TB-1 and TB-2 do not identify the material below the fill in these borings as a lacustrine deposit. However, review of the laboratory data from TB-1 and TB-2 and from TB-3 and TB-4 indicates similar moisture contents in the soil immediately

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below the fill for both sets of borings. It is believed that the material below the fill in TB-1 and TB-2 represent the same lacustrine deposit as is identified on the logs of TB-3 and TB-4.

Design Layer 5 - Underlying the lacustrine deposit is a soft to medium gray silty clay deposit which contains a little to some sand and gravel. The clay deposit extends to depths of approximately 43 to 62 feet below the prevailing ground surface elevation, corresponding to Elevations 520 to 535.

Design Layer 6 - The upper medium gray silty clay (Layer 5) is underlain by a somewhat different medium gray silty clay which extends to depths of 72 to 77 feet below the ground surface (Elevation 518 to 522) in TB-3, TB-4 and TB-5. Although this layer exhibits similar strength characteristics as the upper medium deposit, it contains somewhat more sand and exhibits somewhat less plasticity.

Design Layer 7 - In TB-3 and TB-4, a layer of stiff gray silty clay underlies the medium gray silty clay deposits. This lower stiff layer is in turn underlain by hardpan. Review of the boring logs for TB-1 and TB-2 indicates that the standard penetration resistance for the soil directly above the hardpan was observed to range from 7 to 17 blows per foot for a distance of approximately 5 to 15 feet above the hardpan. These blow counts also correspond to a stiff consistency in cohesive soil.

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The stiff gray silty clay encountered in TB-3 and TB-4 extends to depths of approximately 86 to 89 feet below the ground surface (Elevation 508 to 505).

<u>Design Layer 8</u> - The stiff gray silty clay was underlain by a very hard clayey silt to silty clay material locally termed hardpan. This material exhibits standard penetration resistance greater than 50 blows/foot.

<u>Groundwater Conditions</u>

A pneumatic piezometer was installed in the underlying bedrock aquifer within test boring TB-1 during our initial subsurface investigation at the site. Subsequent water level measurements indicated a piezometric elevation of approximately Elevation 605 within the bedrock aquifer. Artesian groundwater conditions were encountered in the hardpan layer during the drilling of both test boring TB-3 and TB-5. Boring TB-4 did not penetrate the hardpan and no groundwater was encountered in this boring. The results of the individual water level observations are shown on the respective Logs of Test Boring.

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SELECTION OF DESIGN PARAMETERS

The results of the field and laboratory testing developed during our investigations of the site have been summarized and evaluated for the purpose of selecting design parameters for use in the slope stability analyses. The following paragraphs present the results of our evaluations and the corresponding design parameters.

<u>Index Properties</u> - For ease of reference, the results of the laboratory testing for soil index properties are presented graphically on Figure 26, Summary of Soil Index Properties. shown on Figure 26, the measured values of total density, moisture content and Atterberg limits are presented for each soil layer at each test boring location. Review of Figure 26 indicates that within Layer 4, total soil density ranges from 115 to 134 pcf, moisture content ranges from 23 to 33 percent, liquid limits range from 24 to 38 percent, and plasticity indices range from 10 to 18 percent. Within Layer 5, total soil density ranges from 128 to 137 pcf, moisture content ranges from 18 to 22 liquid limits range from 21 to 32 percent, and plasticity indices range from 7 to 15 percent. For Layer 6, total soil densities range from 126 to 136 pcf, moisture contents range from 22 to 24 percent, liquid limits range from 31 to 52 percent, and plasticity indices range from 13 to 26 percent, and

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for Layer 7, total soil densities range from 117 to 129 pcf, moisture contents range from 22 to 32 percent, liquid limits range from 29 to 53 percent and plasticity indices range from 13 to 29 percent.

These values indicate consistent results across the site in all layers. Based on these test results, the following design parameters were selected.

Layer 4: Density = 124 pcf

Moisture

Content = 29 %

Layer 5: Density = 133 pcf

Moisture

Content = 21 %

Layer 6: Density = 130 pcf

Moisture

Content = 23 %

Layer 7: Density = 128 pcf

Moisture

Content = 25 %

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Undrained Shear Strength - The results of the vane shear testing and unconfined compressive strength testing performed at the site are summarized on Figures 21 and 22, Summary of Laboratory Data, as well as on Figures 4 through 20, Vane Shear Test Results. Review of these test results from Test borings TE-1 through TB-4 indicate undrained shear strengths ranging from 553 to 1115 psf in Layer 4, ranging from 580 to 846 psf in Layer 5, and ranging from 218 to 924 psf in Layer 6. One vane shear value of 1241 psf was obtained from Layer 7. With the exception of one low shear vane test value in Layer 6 (i.e., 218 psf at the location of test boring TB-3), the remainder of the test results for test borings TB-1 through TB-4 show good agreement across the site.

While index properties tests from borings TB-1 through TB-5 and the triaxial test data indicate uniformity in soil characteristics across the site, the results of the vane shear testing performed in test boring TB-5 are lower than the values recorded in test borings TB-1 through TB-4 for both layers tested. At the location of TB-5 within Layer 5, undrained shear strengths range from 208 to 341 psf and within Layer 6, shear strengths ranging from 186 to 465 psf were recorded. No vane shear tests were performed in Test Boring TB-5 in Layer 7.

Some reduction in shear strengths at the location of test boring TB-5 may be expected due to the lower overburden pressure at the location of TB-5. The shear strength of soil is directly

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proportional to the overburden pressure. In the vicinity of test boring TB-5, the cell has been excavated, such that the existing overburden is approximately 30 feet lower than the prevailing ground surface elevation. Therefore, we would expect the soil strengths under the floor of the cell to be lower than the soil strengths under the sides of the cell. The vane shear test generally measures available in-situ shear strength which is a function of the available overburden pressure.

However, considering the consistency of index properties and triaxial test data across the site we believe that the shear strength measured by the vane shear test may also be low due to a malfunction of the vane shear device during field operations.

do not believe that the lower shear strengths recorded at the location of test boring TB-5 are significant with respect to the stability of the cell. The results of our slope stability analysis, presented in a later section of this report, indicate that the critical slope failure surfaces are located under the sides of the cell. Therefore, the shear strength of the native subsoils contributing to the stability of the slopes are best represented by the results of soil testing performed on samples from TB-1 through TB-4.

We therefore selected undrained shear strength parameters, after accounting for sampling disturbance, for use in the slope

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stability analysis based on the results of the vane shear and unconfined compressive strength test results from the relevant test borings TB-1 through TB-4 as follows:

Layer 4: c = 880 psf

Layer 5: c = 880 psf

Layer 6: c = 880 psf

Layer 7: c = 3000 psf

Triaxial Shear Strength Results - The results of the triaxial shear strength results are presented in Figure 23, Summary of Triaxial Shear Strengths. These results were evaluated in accordance with the method presented by Lambe and Whitman in their text entitled "Soil Mechanics". This diagram represents various states of stress for a given soil, and allows a comparison of the cohesion values obtained for the various samples during the triaxial testing with an adjustment for the overburden stress of each individual sample.

For a p-q diagram, the peak points of the stress-strain curves from triaxial tests (or p and q at failure) are plotted. A curved line can be drawn through these points; this curve can be approximated by a straight line over the stress range of interest. The equation of the straight line can then be obtained from the slope and intercept, and the shear strength is represented as a function of vertical pressure.

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Using the p-q test results, we developed both effective and total parameters for the slope stability analysis. Based on the test results, the native soils at the site exhibit both cohesive and frictional strength in both the drained (effective stress) and undrained (total stress) conditions.

For design purposes, we have selected the following shear strength parameters for each layer.

Layer 5: Effective Stress Parameters

c' = 0 psf

 $\phi' = 24^{\circ}$

Total Stress Parameters

c = 850 psf

 $\phi = 8^{\circ}$

Layer 6: Effective Stress Parameters

c' = 0 psf

 $\phi^{\dagger} = 24^{\circ}$

Total Stress Parameters

c = 540 psf

 $\phi = 12$ °

Layer 7: Effective Stress Parameters

c' = 0 psf

 $\phi' = 35^{\circ}$

Total Stress Parameters

c = 3000 psf

 $\phi = 0$

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It should also be noted that the stiff gray silty clay (Layer 7) is underlain by a very hard clayey silt to silty clay material locally termed hardpan. This material has standard penetration resistance greater than 50 blows/foot. For design purposes, the hardpan was assigned a cohesion value of 10,000 psf.

Design Configuration

Review of the design drawings prepared by MCI prompted the development of two different design configurations for slope stability analysis. Review of Section A-A on sheet 11 of the MCI drawings indicates that the east and west sides of Cell II have slightly different configurations.

<u>East Side</u> - The configuration of the east side of Cell II is presented on Plates 3B, 4B and 5B. Review of these plates indicates that the east side of Cell II contains a compacted clay berm located adjacent to the non-hazardous waste cell. The berm is underlain by native soil.

West Side - The configuration of the west side of Cell II is presented on Plates 3A, 4A and 5A. These plates indicate that the west side of Cell II contains a compacted clay berm located immediately adjacent to solid waste fill and supported on a thin fill layer. This lower fill layer is underlain by native soil.

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The selection of design parameters for the upper fill materials are discussed below.

Fill Material

Layer 1 consists of compacted clay fill for the liner and stabilization berm. Design parameters for use in the slope stability analysis were selected from the APCM Liner Engineering Report. The parameters utilized for design include total density of 130 pcf, cohesion of 2500 psf, and friction angle of zero. Layer 2 consists of landfill material in the adjacent cell. material consists of industrial wastes such as slag sand and fly For design purposes, it has been assumed that this fill material has a total density of 125 pcf, an angle of internal friction of 25 degrees and no cohesion. Layer 3 consists of fill material encountered at the top of the compacted clay berms during the current and previous subsurface investigations. This material consists of silty clay with traces of brick and concrete fragments. For design purposes, this layer has been assigned a total density of 130 pcf, cohesion of 1000 psf and $\phi = 0$.

SUMMARY OF DESIGN PROFILES

A summary of the design profiles for the undrained (ϕ = 0), as well as total stress parameters are presented in Tables 1 and 2 below:

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TABLE 1
DESIGN UNDRAINED STRENGTH PARAMETERS

Layer	Description	Total Density (pcf)	Cohesion (psf)	Angle of Internal Friction-φ
1	Compacted Clay Liner	130	2500	0°
2	Solid Waste Fill Slag Sand and Fly Ash	125	0	25°
3	Clay Berm	130	1000	0 °
4	Stiff Gray Silty Clay	130	880	0 °
5	Medium Gray Silty Clay	130	880	0 °
6	Medium Gray Silty Clay	130	880	0 °
7	Stiff Gray Silty Clay	128	3000	0 °
8	Hardpan	130	10,000	0°

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TABLE 2

DESIGN STRENGTH PARAMETERS
TOTAL STRESS ANALYSIS

<u> Layer</u>	Description	Total Density (pcf)	Cohesion (psf)	Angle of Internal Friction- ϕ
1	Compacted Clay Liner	130	2500	0°
2	Solid Waste Fill Slag Sand and Fly Ash	125	0	25°
3	Clay Berm	130	1000	o°
4	Stiff Gray Silty Clay	124	650	10°
5	Medium Gray Silty Clay	133	650	10°
6	Medium Gray Silty Clay	130	500	12°
7	Stiff Gray Silty Clay	128	3000	0 °
8	Hardpan	130	>10,000	0°

A summary of the design profile for the effective stress (drained) condition is presented in Table 3 below.

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TABLE 3

DESIGN STRENGTH PARAMETERS
EFFECTIVE STRESS ANALYSIS

<u>Layer</u>	Description	Total Density (pcf)	Cohesion (psf)	Angle of Internal Friction- ϕ
1	Compacted Clay Liner	130	2500	0°
2	Solid Waste Fill Slag Sand and Fly Ash	125	0	25°
3	Clay Berm	130	0	25°
4	Stiff Gray Silty Clay	124	250	24°
5	Medium Gray Silty Clay	133	250	24°
6	Medium Gray Silty Clay	130	350	24°
7	Stiff Gray Silty Clay	128	0	35°
8	Hardpan	130	>10,000	>35°

SLOPE STABILITY

It is important to note that the total shearing strength of a soil is defined as s=c+p' tan ϕ ; where c is the cohesion or undrained shear strength of the soil, p' is the effective overburden pressure of the soil, and ϕ is the angle of internal

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friction of the soil. When a soil is initially loaded such that excess pore pressure is induced, the apparent strength of the soil is characteristic of the total shearing strength, i.e., it exhibits both cohesive and frictional strength. With time, however, the excess pore pressure dissipates, and the soil behaves as an essentially frictional material. Therefore, a slope stability analysis needs to include an analysis of both total strength short-term parameters and an effective strength (long-term) parameters. In addition, we examined the case of undrained ($\phi = 0$) conditions.

The stability of the two different design sections were evaluated using both drained and undrained strength parameters. The analysis was performed using a computer program entitled "PC-Slope" which was developed by Geo-Slope Programming Ltd. This software will search for the critical failure surface once the limits of the failure surface are defined. By varying the initiation and termination points of the failure surface, the critical circle for each design profile was located and the corresponding factor of safety defined. The program determines a factor of safety based on the ordinary Bishop and Janbu Methods. The factor of safety based on the Janbu Method of analysis, which is the most conservative, was used for this analysis.

Our analysis also incorporated a construction surcharge of 1000 psf applied to the dike on the east and west sides for a short-

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term drainage condition. This surcharge is intended to simulate loading on the haul road during construction of the cell. In addition, a surcharge of 1000 psf was applied to the east side of the cell for long-term drained stability conditions. This surcharge loading is intended to simulate truck loading on the haul road during filling of the cell.

Results of the Slope Stability Analysis

The slope stability analysis of Cell II was performed for the two different surface configurations (i.e. east side and west side) based on the design strength parameters presented previously. In addition, the design configuration included the confining berms planned for installation around the perimeter of the toe of the cell side slopes.

The results of the stability analysis are tabulated below.

SUMMARY OF FACTORS OF SAFETY

East Side	Factor of Safety
Undrained - $(\phi = 0)$	1.4
Total Stress	1.7
Effective Stress	1.7

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West Side

Undrained - $(\phi = 0)$	1.2
Total Stress	1.3
Effective Stress	1.5

The results of this investigation indicate that the computed factors of safety against failure of the side slopes of Cell I for both short term and long term drainage conditions are adequate for the proposed Hazardous Waste Cell II, based upon construction of the proposed confining berms.

As shown above the lowest safety factor occurs on the west side of the cell for the undrained condition. We believe this value is impacted by the 1000 psf surcharge assumed to exist during the construction condition. While this safety factor is adequate, it may be advisable to maintain traffic on the outside of the berm, away from the edge of the cell, during construction of the cell.

SETTLEMENT ANALYSIS

In conjunction with the original geotechnical investigation performed for the operating license application, one consolidation test was performed, and a settlement analysis for the cell was performed. To confirm the consolidation design parameters used in the original settlement analysis, two

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additional consolidation tests were performed in conjunction with the current investigation. The results of these two additional consolidation tests are presented on Figure Nos. 24 and 25.

Review of these figures indicates that the preconsolidation pressure Pc computed for the current investigation is about 1.7 tsf, and the compression index Cc' ranges from 0.090 to 0.10 inches per inch (in/in). The recompression index Cr' is 0.020 in/in. For the initial settlement analysis, Pc values of about 2.5 tsf, a Cc' value of 0.138 in/in and a Cr' value of 0.026 in/in were used.

The Pc values determined from the present investigation appear to be smaller than those developed in the previous investigation. We have therefore recomputed the estimated maximum and minimum total settlements that may occur under the liner of Cell II.

The results of our settlement analysis indicate an estimated maximum total settlement of approximately 1.4 feet under the center of the cell, and an estimated minimum total settlement of approximately 8 inches under the edge of the cell. These values correspond to an estimated maximum differential settlement of 10 inches which is expected to occur over approximately 300 feet. The major impact of this settlement is expected to be a slight flattening of the hydraulic gradient in the leachate collection system.

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We have also analyzed the effect of this differential settlement on the structural integrity of the pipe planned for installation in the leachate collection system. Based on our analysis, this amount of differential settlement is not expected to structurally damage the pipes.

Very truly yours,

NEYER, TISEO & HINDO, LTD.

Laurel A. Kendall, P.E.

Project Manager

Sherif S. Afifi, T.E.

Geoenvironmental Department Manager

CJG/SSA/sew

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APPENDIX A

TABLE OF CONTENTS

Plates

Plate 1 Test Boring Location Plan

Plate 2 General Notes

Plates 3, 4 and 5 Subsurface Profile, Design

Sections

Figures

Figures 1 through 3 Log of Test Borings TB-3 through

TB-5

Figures 4 through 20 Report of Vane Shear Tests

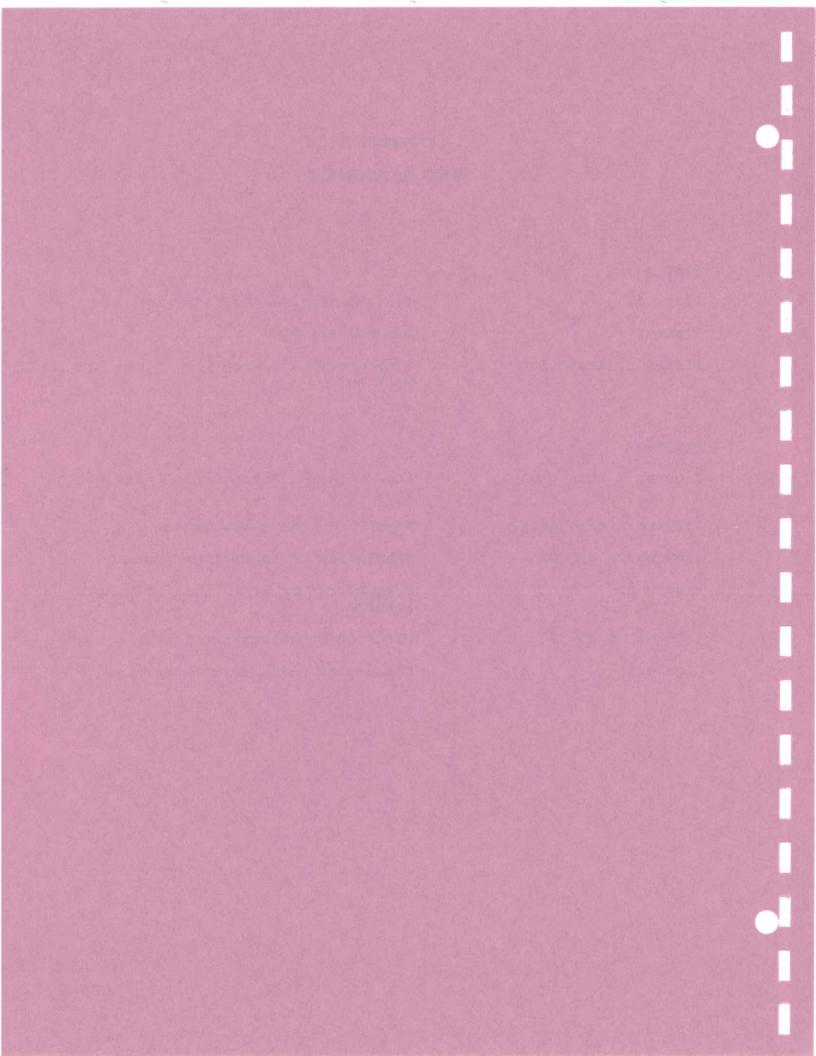
Figures 21 and 22 Tabulation of Laboratory Tests

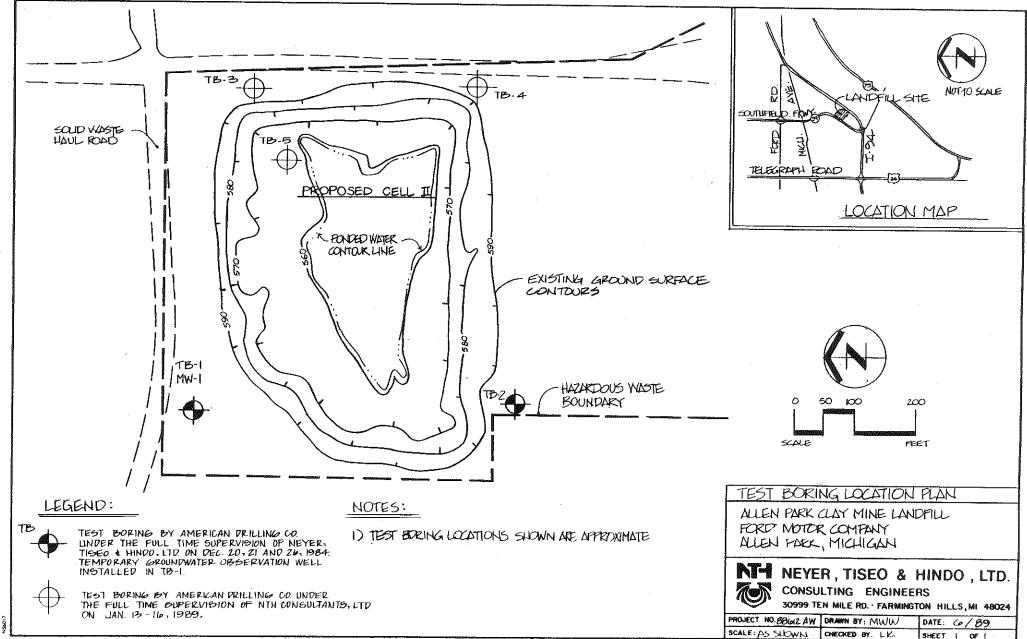
Figure 23 Summary of Triaxial Shear Strength

Results

Figures 24 and 25 Plots of Consolidation Tests

Figure 26 Summary of Soil Index Properties





SHEET I OF PLATE /

NEYER, TISEO & HINDO, LTD.

GENERAL NOTES

TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D 653.

PARTICLE SIZES®

Boulders Greater than 12 inches (305mm) 3 inches (76.2mm) to 12 inches (305mm) Cobbles Gravel - Coarse 3/4 inches (19.05mm) to 3 inches (76.2mm) No. 4 - 3/16 inches (4.75mm) to 3/4 inches (19.05mm) Fine Sand Coarse No. 10 (2.00mm) to No. 4 (4.75mm) No. 40 (0.425mm) to No. 10 (2.00mm) Medium -No. 200 (0.074mm) to No. 40 (0.425mm) Silt 0.005mm to 0.074mm Clay Less than 0.005mm

COHESIONLESS SOILS

Classification The major soil constituent is the principal noun, i.e. sand, silt, gravel. The second major soil constituent and other minor constituents are reported as follows:		Density Classification	Relative Density %	Approximate Range of (N)			
		Very Loose	0-15	0-4			
			Loose	16-35	5-10		
Second Major Constituent (percent by weight)		Minor Constituents (percent by weight)	Medium Compact	36-65	11-30		
	Trace - 1 to 12%	Trace - 1 to 12%	Compact	66-85	31-50		
Adjective - 12 to 35%	Little - 12 to 23%	Very Compact	86-100	Over 50			
(clayey, silty, etc.) And - Over 35%		Some - 23 to 33%		ohesionless Soils is based upon the evaluation of tion Resistance (N), modified as required for ng effects, etc.			

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier; i.e., silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohensionless soils; i.e., silty clay, trace of sand, little gravel.

Consistency	Unconfined Compressive Strength (psf)	Appromixate Range of (N)		
Very Soft	Below 500	0-2		
Soft	500-1000	3-4		
Medium	1000-2000	5-8		
Stiff	2000-4000	9-15		
Verv Stiff	4000-8000	16-30		
Hard	8000-16000	31-50		
Very Hard	Over 16000	Over 50		

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

SAMPLE DESIGNATIONS

AS - Auger Sample - Directly from auger flight.

BS - Miscellaneous Samples - Bottle or Bag.

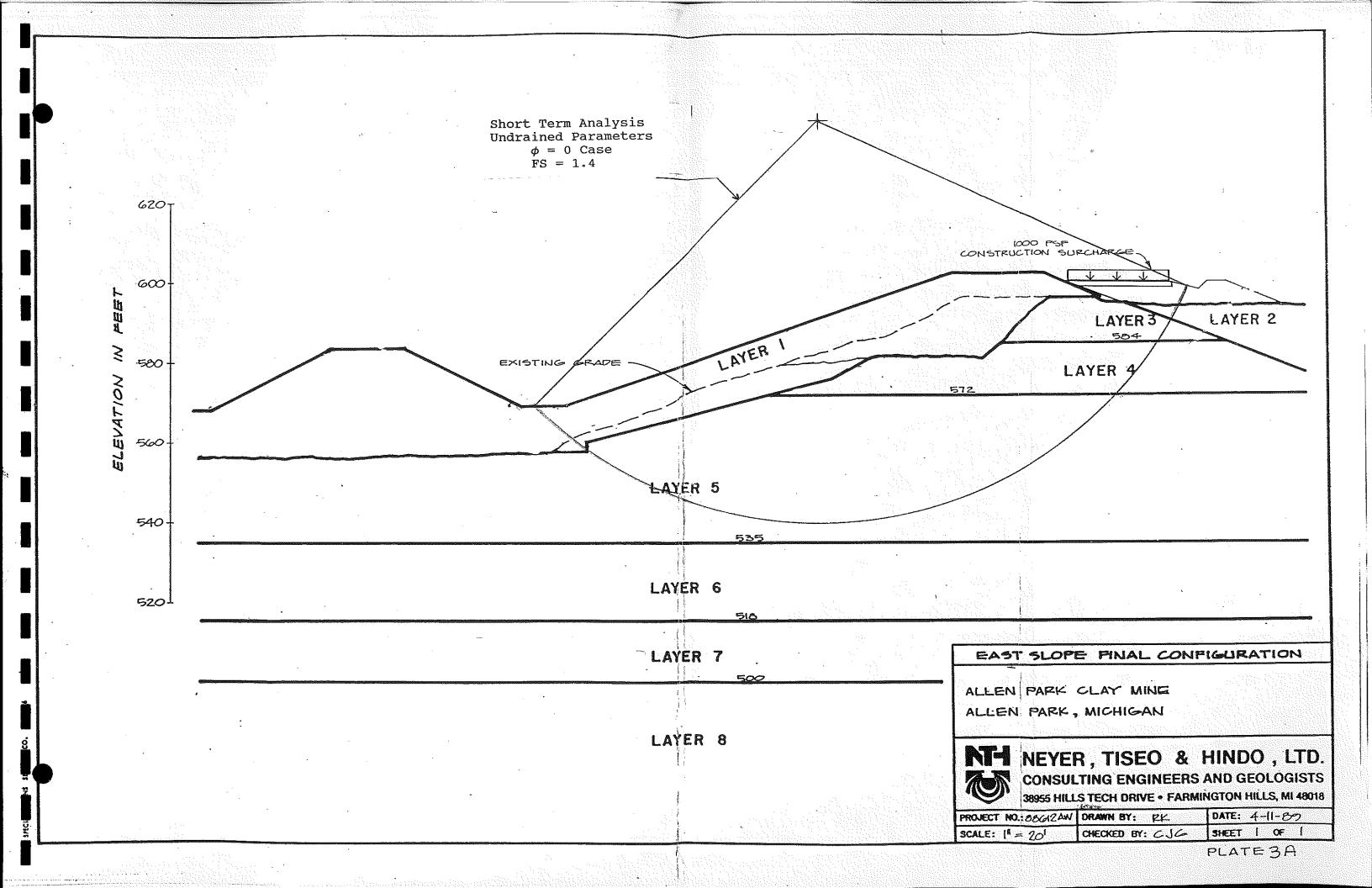
S - Split Spoon Sample with Liner Insert - ASTM D 1586
 LS - Liner Sample S with liner insert 3 inches in length.

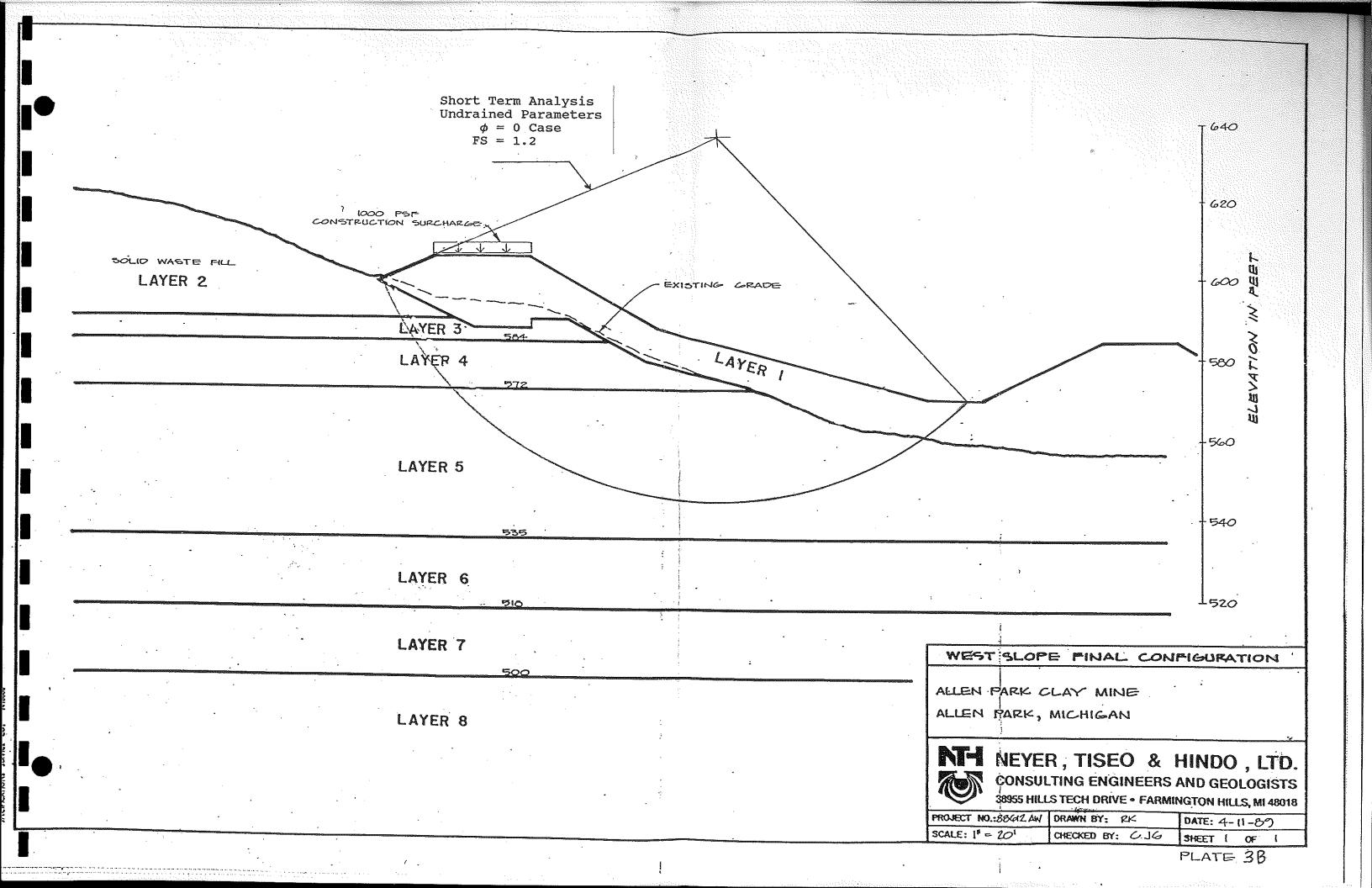
ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted.

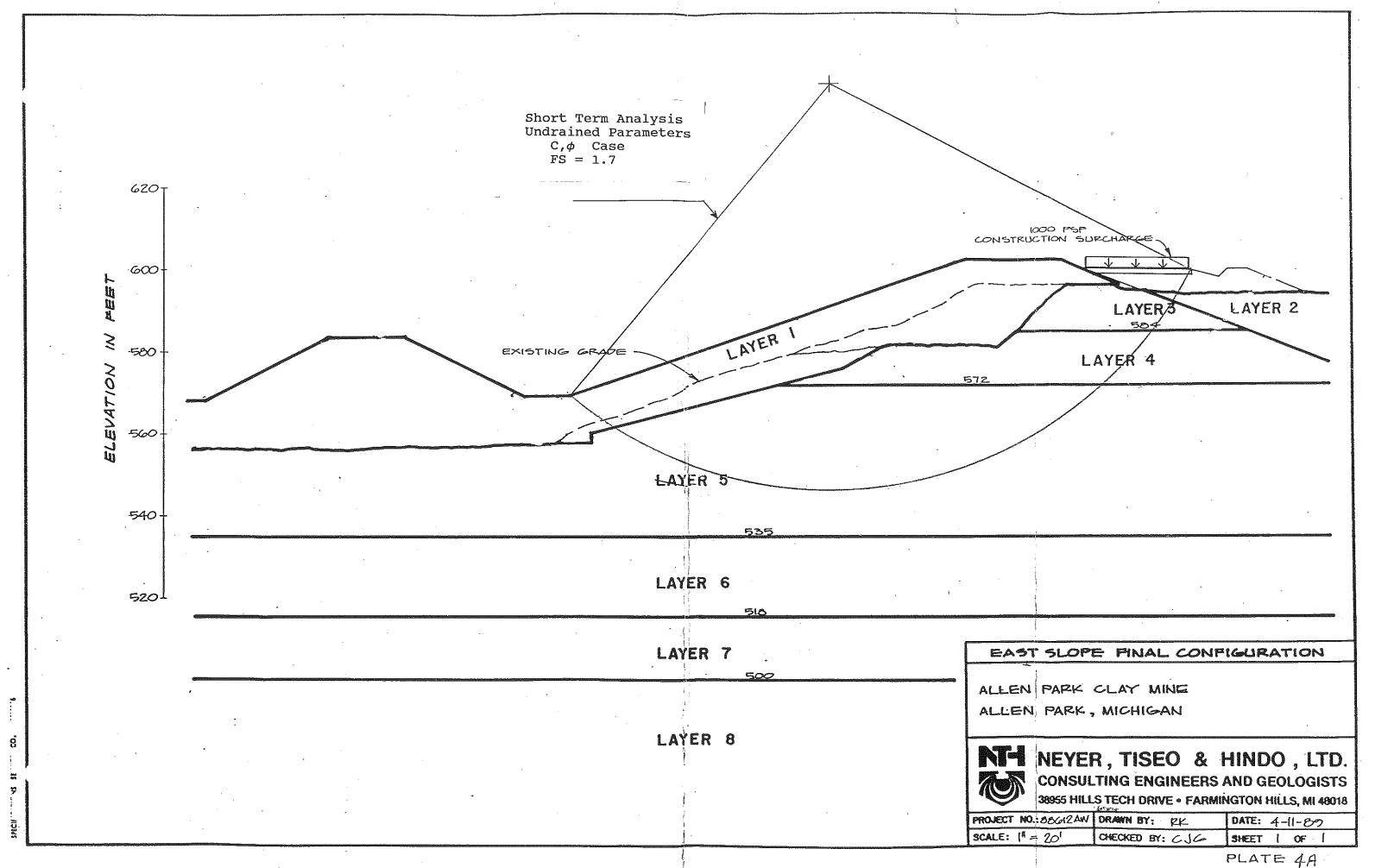
PS - Piston Sample - 3 inch diameter unless otherwise noted.

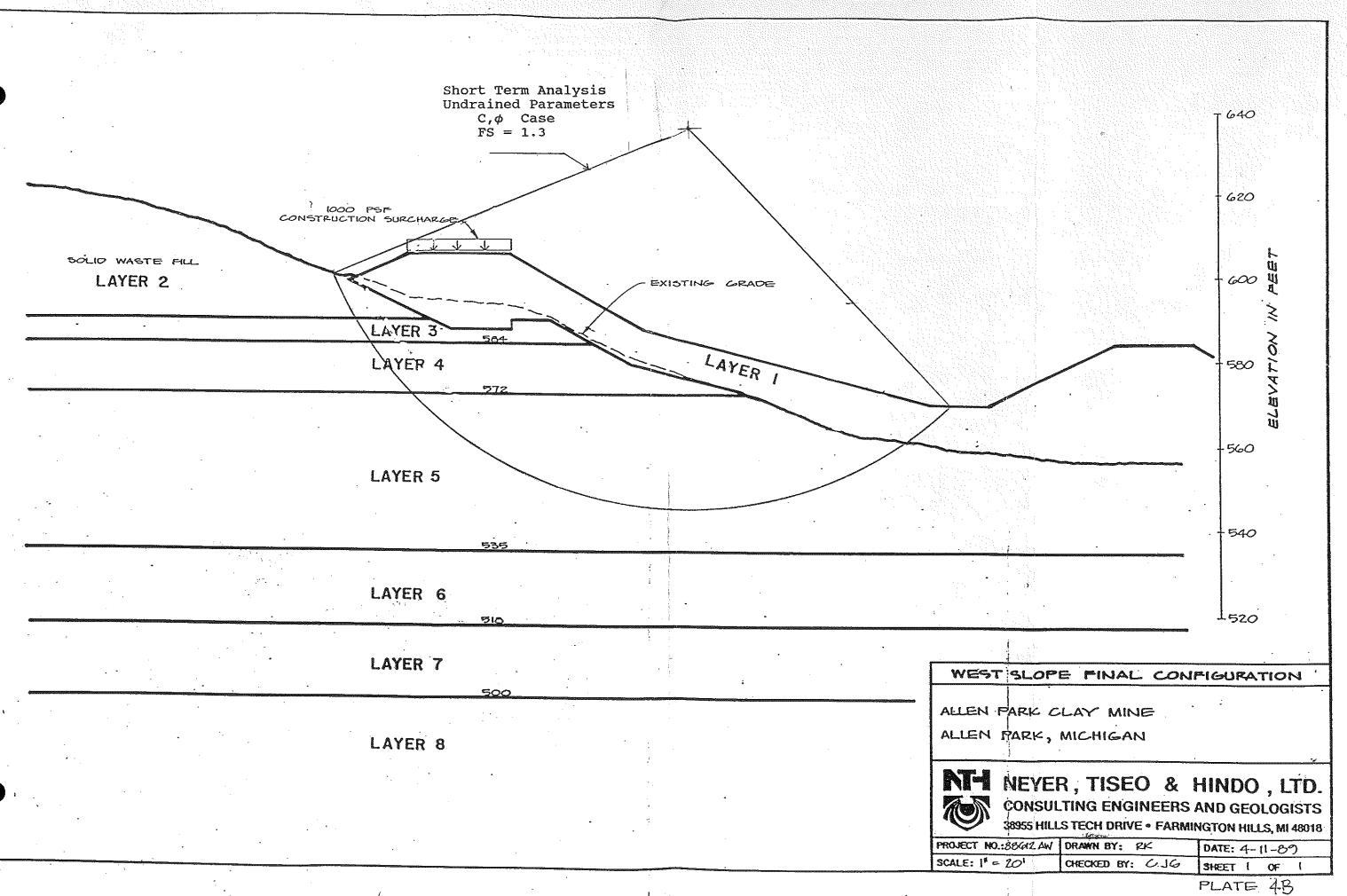
RC - Rock Core - NX core unless otherwise noted.

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0" outside-diameter, 1-3/8" inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).









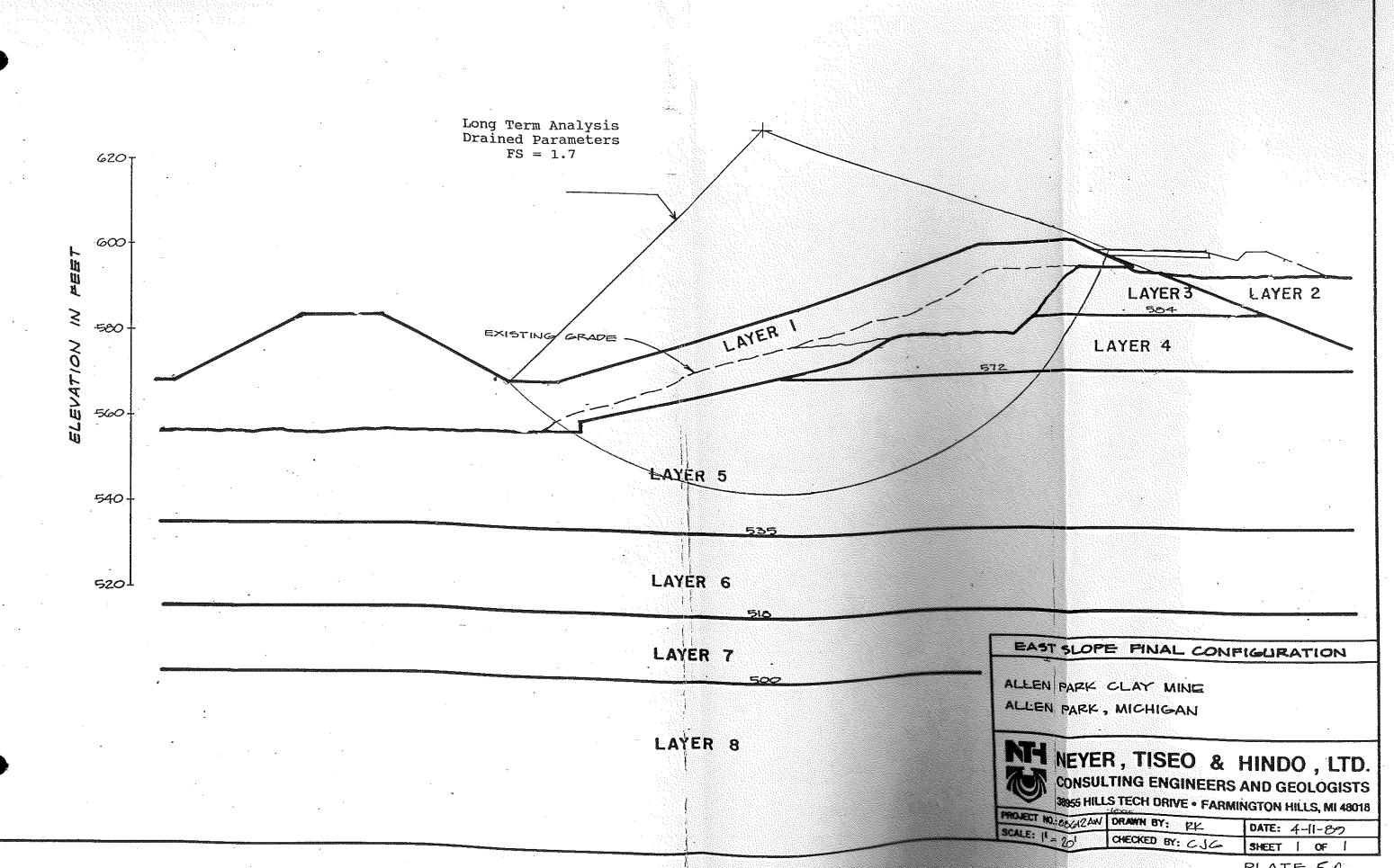
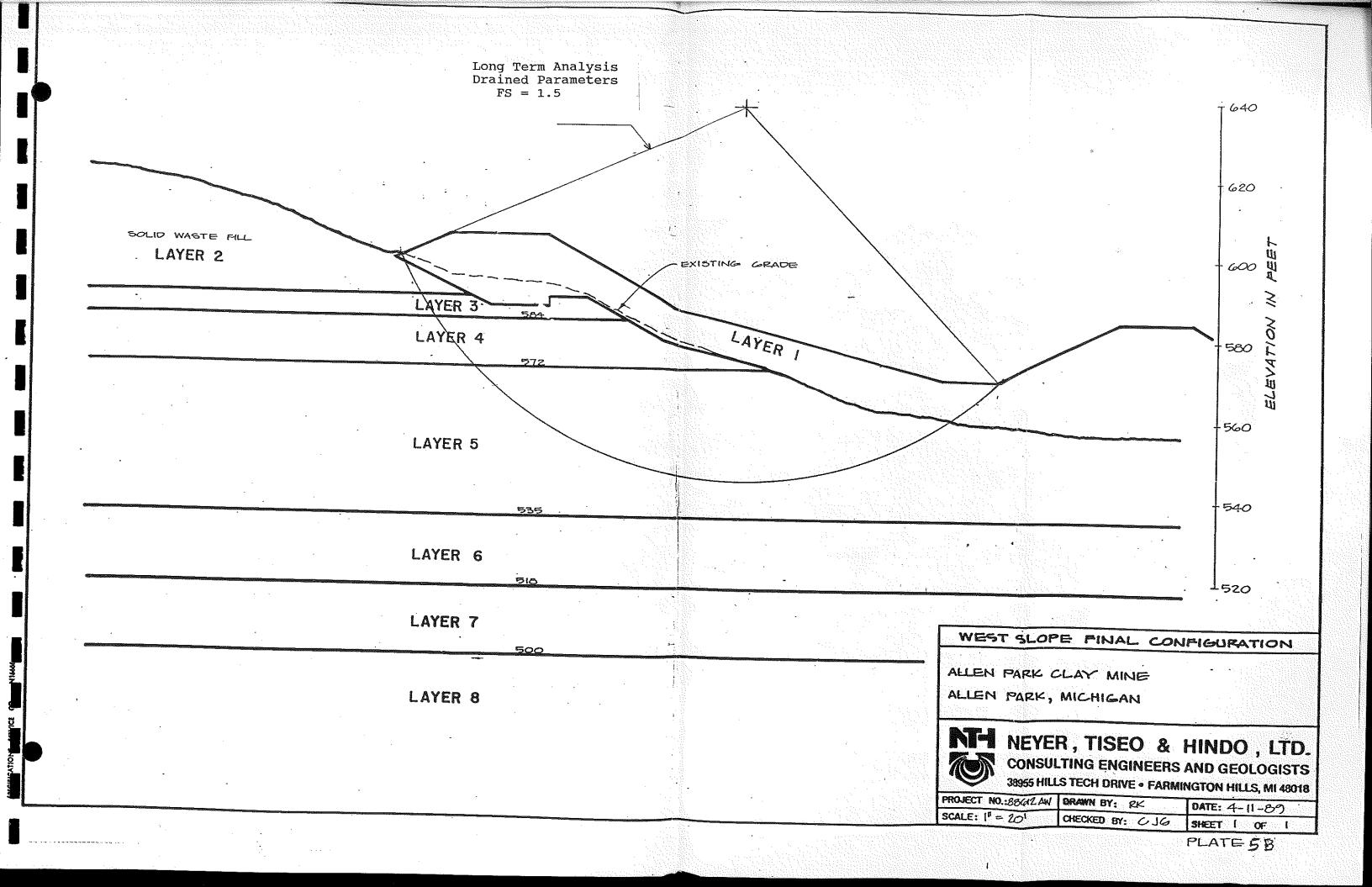


PLATE 5A



NEYER, TISEO & HINDO, LTD.

LOG OF TEST BORING NO. TB-3

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE

NTH Proj. No: 88612 AW Chk. By:

Project Location: ALLEN PARK, MICHIGAN

Project	LOCATION: ALLEN PARK, MICHIGAN		Olin. by. 9//					
	SUBSURFACE PROFILE		SOIL SAMPLE DATA					
ELEY. PRO- (FT) FILE	GROUND SURFACE ELEVATION: 594.7 FT	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)
590	FILL: DARK BROWN SILTY CLAY WITH TRACE OF SAND, GRAVEL AND BRICK FRAGMENTS	5						
585		10	S-1	3 3 5	8	_	_	
	OTHER COAL CLETY CLAY							
580	STIFF GRAY SILTY CLAY WITH TRACE OF SAND	15	S-2			_	_	_
			PS-1			21.5	110	2180
575	19.0	20	VS-1			_		1106*
5		25	PS-2			17.6	117	
565	MEDIUM GRAY SILTY CLAY	- 30	VS-2					1214*
	WITH LITTLE TO SOME SAND AND TRACE OF GRAVEL		-			-		1 1
560		35	PS-			_	•==	
			PS-3			18.3	115	1240
555		40	VS-3			_	<u> </u>	1186*
	CONTINUED ON NEXT SHEET	-						
			1		epontal por en	· · · · · · · · · · · · · · · · · · ·		

TOTAL DEPTH: DRILLING DATE: INSPECTOR: CONTRACTOR:

DRILLER:

89.5 FT 1/13-16/89 V. PERSON/A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLING METHOD:
4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET,
3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE: HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.
ARTESIAN CONDITIONS WERE ENCOUNTERED AT END OF BORING.

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$)

COORDINATES: N 3986.1 / E 6679.4

FIGURE No. 1A

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LOG OF TEST BORING NO. TB-3

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE Project Location: ALLEN PARK, MICHIGAN

NTH Proj. No: 88612 AW Chk. By:

***************************************		SUBSURFACE PROFILE		SOIL SAMPLE DATA					
ELEY. (FT)	PRO- FILE	CONTINUED FROM PREVIOUS SHEET	DEPTH (FT)	SAMPLE TYPE/NO.	8LOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)
550	0,000		 45	PS-4			19.4	112	1560
545		MEDIUM GRAY SILTY CLAY	50	VS-4					1692*
		WITH LITTLE TO SOME SAND AND TRACE OF GRAVEL	-						
5 4 0	4 4		55	PS-5			19.6	112	1420
535 	CO	· · · - 6	60	VS-5			_		1810*
 530	. Kee		65	PS-6			22.7	105	1420
525	8 8 8	MEDIUM GRAY SILTY CLAY WITH LITTLE TO SOME SAND AND TRACE OF GRAVEL	- - - 70	VS-6					1848*
 520 			75	PS-7			24.3	109	_
515		STIFF GRAY SILTY CLAY WITH TRACE TO LITTLE SAND	7.0 - 80.0 80	- - VS-7			_	_	1241*
		CONTINUED ON NEXT SHEET	-	-					

TOTAL DEPTH:
DRILLING DATE:
INSPECTOR:
CONTRACTOR:

DRILLER:

89.5 FT 1/13-16/89 V. PERSON/A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLING METHOD:
4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET,
3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE: HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.
ARTESIAN CONDITIONS WERE ENCOUNTERED AT END OF

* AS DETERMINED BY A VANE SHEAR TEST ($2S_{U} = q_{U}$)

COORDINATES: N 3986.1 / E 6679.4

FIGURE NO. 1B

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NEYER, TISEO & HINDO, LTD. LOG OF TEST BORING NO. TB-3 Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE NTH Proj. No: 88612 AW Chk. By: Cf Project Location: ALLEN PARK, MICHIGAN SOIL SAMPLE DATA SUBSURFACE PROFILE STD. PEN. MOISTURE RESISTANCE CONTENT (N) (PERCENT) DRY UNCONF. DENSITY COMP. ST. (PCF) (PSF) BLOWS/ 6-INCHES DEPTH (FT) SAMPLE TYPE/NO. ELEV. PRO-(FT) FILE CONTINUED FROM PREVIOUS SHEET STIFF GRAY SILTY CLAY WITH TRACE TO LITTLE SAND 510 85 PS-8 86.0 19 25 30 HARD GRAY CLAYEY SILT WITH SOME SAND S-3 55 [HARDPAN]89.5 505 90 END OF BORING 500 95 495 100 490 105 485 110 480 115 475 120 89.5 FT 1/13-16/89 V. PERSON/A. AUGUSTYNIAK AMERICAN DRILLING CO. TOTAL DEPTH: DRILLING DATE: INSPECTOR:

CONTRACTOR: DRILLER:

M. MAYRAND

DRILLING METHOD: 4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET, 3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE:
HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.

ARTESIAN CONDITIONS WERE ENCOUNTERED AT END OF BORING.

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$)

COORDINATES: N 3986.1 / E 6679.4

FIGURE NO. 10

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LOG OF TEST BORING NO. TB-4

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE Project Location: ALLEN PARK, MICHIGAN

NTH Proj. No: 88612 AW Chk. By: A-

Project L	ocation: ALLEN PARK, MICHIGAN	Спк. Бу: 90-							
	SUBSURFACE PROFILE	SOIL SAMPLE DATA							
ELEV. PRO- (FT) FILE	GROUND SURFACE ELEVATION: 594.0	FT	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)
590	FILL: DARK BROWN SILTY CLAY WITH PIECES OF BRICK		5	- April Market	5 4 4				
	LOOSE TAN SAND	9.5 9/.7		S-1	Ā	8	-		
580			15	S-2	4 4 7	11	33.2	88	2060
575 4	STIFF GRAY SILTY CLAY WITH TRACE OF SAND AND GRAVEL	22.(20	PS-1			30.0	95	2230
570			25	VS-1			-		1538*
565	MEDIUM GRAY SILTY CLAY		30	PS-2			19.5	113	1350
560	MEDIUM GRAY SILTY CLAY WITH LITTLE SAND AND TRACE OF GRAVEL		35	VS-2			_	_	1332*
555			40	PS-3			19.2	112	1440
	CONTINUED ON NEXT SHEET		-						

TOTAL DEPTH:
DRILLING DATE:
INSPECTOR:
CONTRACTOR:
DRILLER:

90.0 FT 1/17-19/89 A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLING METHOD:

4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET, 3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE: HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$)

COORDINATES: N 4025.7 / E 7156.8

FIGURE NO. 2A

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LOG OF TEST BORING NO. TB-4

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE Project Location: ALLEN PARK, MICHIGAN

NTH Proj. No: 88612 AW Chk. By:

Project L	ocation: ALLEN PARK, MICHIGAN	Chk. By: 41—						
	SUBSURFACE PROFILE	SOIL SAMPLE DATA						
ELEY. PRO- (FT) FILE	CONTINUED FROM PREVIOUS SHEET	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)
6								
550		45	VS-3			_	_	1500*
	MEDIUM GRAY SILTY CLAY WITH LITTLE SAND AND TRACE OF GRAVEL					~		
545		50	PS-4			21.0	115	1140
540		55	VS-4			_	_	1174 *
	57.0		V3-4					11/4
535		-						
		60	PS-5			22.2	107	_
			-					
530	MEDIUM GRAY SILTY CLAY WITH LITTLE SAND AND TRACE OF GRAVEL	65	VS-5			_	_	436*
			1					
525		70	PS-6			24.1	105	
	72.	0						+
520		- 75	VS-6	:		_	_	1118*
	STIFF GRAY SILTY CLAY WITH TRACE OF SAND AND GRAVEL	/3	1 73-0					1116
515	•	80		9 13 15			_	
	CONTINUED ON NEXT SHEET	- 80	5-3	15	28		<u> -</u>	
			<u> </u>			*****		

TOTAL DEPTH:
DRILLING DATE:
INSPECTOR:
CONTRACTOR:

DRILLER:

90.0 FT 1/17-19/89 A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLING METHOD:
4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET,
3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE:
HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$)

COORDINATES: N 4025.7 / E 7156.8

FIGURE No. 2^B

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LOG OF TEST BORING NO. TB-4

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE Project Location: ALLEN PARK, MICHIGAN

NTH Proj. No: 88612 AW Chk. By:

		SUBSURFACE PROFILE		SOIL SAMPLE DATA						
ELEY. PI (FT) F	RO-	CONTINUED FROM PREVIOUS SHEET	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)	
510		STIFF GRAY SILTY CLAY WITH TRACE OF SAND AND GRAVEL	85	5-4	3 5 6	11	_		_	
505		HADD CDAY STITY CLAY 90.		S-5	9 13 24	37	_			
	* 1 /-	HARD GRAY SILTY CLAY WITH TRACE OF GRAVEL END OF BORING			,					
500			95					•		
495			100							
		•								
490			105							
485			110							
									ţ	
480			115							
475			-							
			120							

TOTAL DEPTH:
DRILLING DATE:
INSPECTOR:
CONTRACTOR:

90.0 FT 1/17-19/89 A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLER:

DRILLING METHOD:
4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET,
3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE:
HOLE PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:
NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$)

COORDINATES: N 4025.7 / E 7156.8

FIGURE No. 2^C

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LOG OF TEST BORING NO. TB-5

Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE Project Location: ALLEN PARK, MICHIGAN

NTH Proj. No: 88612 AW Chk. By:

	SUBSURFACE PROFILE SPRO- GROUND SURFACE ELEVATION: 563.2 FT DEPTH (FT)				SAMPL	E DATA		Livicous
ELEV. PRO- (FT) FILE	GROUND SURFACE ELEVATION: 563.2 FT	DEPTH (FT)	SAMPLE TYPE/NO.	BLOWS/	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	UNCONF. COMP. ST. (PSF)
560			PS-			_	-	
			PS-					
555		10						
			PS-1		!	20.9	109	-
550								
		15	VS−1			-		416*
545								
	SOFT TO MEDIUM GRAY SILTY CLAY WITH LITTLE TO SOME SAND AND TRACE OF GRAVEL	20	PS-2			21.0	111	-
540	TRACE OF GRAVEL							
535		25	VS-2			_		682*
		30	PS-3			22.1	104	_
530								1
		35	VS-3			_		372*
525		-			-			
- 119		40	PS-4			21.6	109	_
	CONTINUED ON NEXT SHEET		1	-				

TOTAL DEPTH:
DRILLING DATE:
INSPECTOR:
CONTRACTOR:

58.3 FT 1/19-20/89 A. AUGUSTYNIAK AMERICAN DRILLING CO. M. MAYRAND

DRILLER:

DRILLING METHOD:
4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET,
3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE:

HOLE PRESSURE-PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:

NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.
ARTESIAN CONDITIONS WERE ENCOUNTERED AT END OF

* AS DETERMINED BY A VANE SHEAR TEST ($2S_u = q_u$) COORDINATES: N 3820.8 / E 6850.3

FIGURE No. 3A

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NEYER, TISEO & HINDO, LTD. LOG OF TEST BORING NO. TB-5 Project Name: SUPPLEMENTAL SUBSURFACE INV. / ALLEN PARK CLAY MINE NTH Proj. No: 88612 AW Chk. By: CA-Project Location: ALLEN PARK, MICHIGAN SOIL SAMPLE DATA SUBSURFACE PROFILE BLOWS/ 8-INCHES STD. PEN. MOISTURE CONTENT (N) (PERCENT) UNCONF. COMP. ST. (PSF) DRY DENSITY (PCF) SAMPLE TYPE/NO. PRO-FILE ELEY. (FT) CONTINUED FROM PREVIOUS SHEET SOFT TO MEDIUM GRAY SILTY CLAY WITH LITTLE TO SOME SAND AND TRACE OF GRAVEL 520 **VS-4** 930* 45 515 STIFF GRAY SILTY CLAY 50 PS-5 24.7 100 WITH LITTLE SAND AND TRACE OF GRAVEL 510 3 55 5-1 8 56.9 85 505 S-2 37.2 HARD GRAY SILTY CLAY [HARDPAN] 58.3 60 END OF BORING 500 65 495 70 490 75

80

TOTAL DEPTH: DRILLING DATE: INSPECTOR: CONTRACTOR:

DRILLER:

485

58.3 FT 1/19-20/89 A. AUGUSTYNIAK AMERICAN DRILLING CO.

M. MAYRAND

DRILLING METHOD:

4.0 INCHES DIAMETER SOLID STEM AUGER TO 10.0 FEET, 3.8 INCHES DIAMETER ROTARY ROLLER BIT WITH DRILLING FLUID (WATER) RECIRCULATION.

PLUGGING PROCEDURE:

HOLE PRESSURE-PLUGGED WITH NON-SHRINKING CEMENT GROUT.

WATER LEVEL OBSERVATION:

NO MEANINGFUL WATER DATA AT COMPLETION SINCE
WATER ADDED TO DRILL HOLE.

ARTESIAN CONDITIONS WERE ENCOUNTERED AT END OF BORING.

* AS DETERMINED BY A VANE SHEAR TEST $(2S_{ii} = q_{ii})$ COORDINATES: N 3820.8 / E 6850.3

FIGURE NO. 3B

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	12 OW Park, Michiga	n Pi	ROJECT NAME: DAT	Allen Park Cla E: 1/13/89	y Mine
	FIEL	D VANE SHEA	R TEST REPO	ORT	
TEST NO.			ELEV. TOP OF H		594.7
BORING HOLE	NO. T	B-3	DEPTH TO TEST	POINT	20.0'
LINK & STA.	-			POINT	574.7
OFFSET			(Tip of Va	ne)	
		VANE	DATA		
TORQUE ARM LG	TH. <u>12</u> IN.	• -			
VANE LGTH.					
VANE DIA	<u></u> IN.				
	<u> </u>			<u>.</u> 7	
				•	
					_
		(s) = 5.17	_ x APPLIED TO	RQUE (T) (in . — ibs.)	ı. — Ibs.)
	/ sq. ft.)		<u> </u>		Se de la constant de
FRICTION ON V		UNDISTURBED	CONDITION	REMOLDED	
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Rotation degrees	Force Gage Reading (Ibs
		20	8.5	50	3.2
ļ				 	
		25	8.5	55	4.0
		25 30	8.5 8.0	55 60	4.0
 READINGS &	 CALCULATIONS	30 35	8.0 8.0	60	4.0
		30 35	8.0	60 65 UNDISTURBED	4.0 4.0
MAXIMUM FOR	CE GAGE REA	30 35	8.0 8.0 (lbs.)	60 65 UNDISTURBED CONDITION	4.0 4.0 REMOLDED CONDITION
MAXIMUM FOR	CE GAGE REA	30 35 S DINGS for VANE	8.0 8.0 (lbs.)	60 65 UNDISTURBED CONDITION 8.5	4.0 4.0 REMOLDED CONDITION 4.0
MAXIMUM FORCE (CE GAGE REALIDER GAGE REALIDER.)	30 35 S DINGS for VANE	8.0 8.0 (lbs.)	60 65 JNDISTURBED CONDITION 8.5	4.0 4.0 REMOLDED CONDITION 4.0
MAXIMUM FORCE (NET FORCE (APPLIED TORG	CE GAGE REALIDER GAGE REALIDER.)	30 35 DINGS for VANE DINGS for SHAFT	8.0 8.0 (lbs.)	60 65 JNDISTURBED CONDITION 8.5 102	4.0 4.0 REMOLDED CONDITION 4.0 48
MAXIMUM FORCE (NET FORCE (APPLIED TORG	CE GAGE REA Ibs.) PUE (T) = NET I EAR STRENGT Shear Str	30 35 Sings for vane DINGS for SHAF* FORCE x TORQUE H (S) = 1 Ar rength (undistu	8.0 8.0 (Ibs.) T (Ibs.) T ARMS (inibs.) T T	60 65 JNDISTURBED CONDITION 8.5 102	4.0 4.0 REMOLDED CONDITION 4.0 48
MAXIMUM FORCE (NET FORCE (APPLIED TORCE ULTIMATE SH SENSIVITY =	CE GAGE REALIBS.) DUE (T) = NET I EAR STRENGT Shear St	30 35 DINGS for VANE DINGS for SHAF* FORCE x TORQUE 'H (S) =i Ar	8.0 8.0 (lbs.) T (lbs.) = ARMS (inibs.) - T rbed) ded)	60 65 JNDISTURBED CONDITION 8.5 102 527	4.0 4.0 REMOLDED CONDITION 4.0 48 248
MAXIMUM FORCE (NET FORCE (APPLIED TORCE ULTIMATE SH SENSIVITY =	CE GAGE REALIDS.) DUE (T) = NET I EAR STRENGT Shear Strengt Shear Strengt	30 35 Sings for Vane DINGS for SHAF* FORCE x TORQUE H (S) = i Ar rength (undisturted)	8.0 8.0 (lbs.) T (lbs.) = ARMS (inibs.) - T rbed) ded)	60 65 JNDISTURBED CONDITION 8.5 102 527	4.0 4.0 REMOLDED CONDITION 4.0 48 248
MAXIMUM FORCE (NET FORCE (APPLIED TORCE ULTIMATE SH SENSIVITY =	CE GAGE REALIDS.) DUE (T) = NET I EAR STRENGT Shear Strengt Shear Strengt	30 35 DINGS for VANE DINGS for SHAF* FORCE x TORQUE H (S) = I Ar rength (undisturted) rength (remoins	8.0 8.0 (lbs.) (lbs.) T (lbs.) T arbed) ded) HALF-UNCONFI	60 65 JNDISTURBED CONDITION 8.5 102 527 2.1 NED COMPREH Ibs. / sq. 1	4.0 4.0 REMOLDED CONDITION 4.0 48 248
MAXIMUM FORCE MAXIMUM FORCE NET FORCE (APPLIED TORCE ULTIMATE SH SENSIVITY = NATURAL W CONTENT	CE GAGE REALIBS.) DUE (T) = NET I EAR STRENGT Shear Strengt ATER A. Augustyr	30 35 DINGS for VANE DINGS for SHAF* FORCE x TORQUE H (S) = I Ar rength (undistuing the content of the con	8.0 8.0 (lbs.) T (lbs.) T arbed) ded) HALF-UNCONFISTRENGTH	60 65 JNDISTURBED CONDITION 8.5 102 527 2.1 NED COMPREH Ibs. / sq. 1	4.0 4.0 REMOLDED CONDITION 4.0 48 248 ENSIVE

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PROJECT NAME: Allen Park Clay Mine DATE: 1/13/89	2022	0.011		0 & HINDO, LT	teritoria de la companya de la comp	
FIELD VANE SHEAR TEST REPORT TEST NO. VS-2						<u>y Mine</u>
TEST NO. VS-2					The Contract of the Section of the S	
BORING HOLE NO.						
LINK & STA ELEV. OF TEST POINT						
VANE DATA					•	
TORQUE ARM LGTH. 12 IN. VANE LGTH. 3.5 IN. VANE DIA. 2.0 IN. ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) {In Ibs.} FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Redding (Ibs.) Rotation degrees Reading (Ibs.) Remolded) Remolded (Ibs.)					-	
TORQUE ARM LGTH. 12 IN. VANE LGTH. 3.5 IN. VANE DIA. 2.0 IN. ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) {In Ibs.} FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Redding (Ibs.) Rotation degrees Reading (Ibs.) Remolded) Remolded (Ibs.)	**************************************	Company of the Compan	VANE	DATA		
ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) { in. — ibs. } FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation Force Gage Reading (lbs.) Regrees Reg	TORQUE ARM LG	rh. <u>12</u> in.			, , , , , , , , , , , , , , , , , , ,	
FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation degrees Force Gage Reading (lbs.) Rea					· v	
Rotation degrees Reading (lbs.) Rotation degrees Reading (lbs.) 4.9 70 8.9 10 4.9 80 8.9 10 4.9 READINGS & CALCULATIONS UNDISTURBED CONDITION COMPREHENSIVE CONTENT C	(1bs. ,	/ sq. ft.)		(in.	— lbs.)	
75 8.9 10 4.9 80 8.9 10 4.9 READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION MAXIMUM FORCE GAGE READINGS for VANE (lbs.) 8.9 4.9 MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) 8.9 4.9 APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) 106.8 58.8 ULTIMATE SHEAR STRENGTH (S) = 1/Ar T 552 304 SENSIVITY = Shear Strength (undisturbed) 1.8 Shear Strength (remoided) NATURAL WATER CONTENT % STRENGTH Ibs./ sq. ft. TECHNICIAN A. Augustyniak CHECKED BY C. Griffin	degrees	Reading (1bs.)	degrees	Reading (lbs.)	degrees .	Reading (lbs
80 8.9 10 4.9 85 8.9 10 4.9 READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION MAXIMUM FORCE GAGE READINGS for VANE (lbs.) 8.9 4.9 MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) 8.9 4.9 APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) 106.8 58.8 ULTIMATE SHEAR STRENGTH (S) = 1	W 122	41 144	70	8.9	10.	4.9
READINGS & CALCULATIONS MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (in - ibs.) ULTIMATE SHEAR STRENGTH (S) = I Ar		MOT MANA	75	8.9	10	4.9
READINGS & CALCULATIONS MAXIMUM FORCE GAGE READINGS for VANE (Ibs.) MAXIMUM FORCE GAGE READINGS for SHAFT (Ibs.) NET FORCE (Ibs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (in - ibs.) ULTIMATE SHEAR STRENGTH (S) =		BO 600	80	8.9	10	4.9
MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) =i			85	8.9	10	4.9
MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = I T	READINGS &	CALCULATIONS	3	Ų	NDISTURBED CONDITION	REMOLDED
MAXIMUM FORCE GAGE READINGS for SHAFT (Ibs.) NET FORCE (Ibs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = I	MAXIMUM FORC	E GAGE REA	DINGS for VANE	(lbs.)		4.9
NET FORCE (Ibs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (in - ibs.) ULTIMATE SHEAR STRENGTH (S) =I	MAXIMUM FORC	E GAGE REA	DINGS for SHAFT	r (Ibs.)		
APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = I	NET FORCE (lbs.)	The state of the s			
ULTIMATE SHEAR STRENGTH (S) = I T 552 304 SENSIVITY = Shear Strength (undisturbed) = 1.8 Shear Strength (remoided) NATURAL WATER	APPLIED TORQ	UE (T) = NET	FORCE x TORQUE	ARMS (in ibs.)		
SENSIVITY = Shear Strength (undisturbed) = 1.8 Shear Strength (remoided) NATURAL WATER	IN TIMESTE CHE	EAR STRENGT	'H (S) = - 1	- T		
Shear Strength (remoided) NATURAL WATER CONTENT	INTIMALE SUE			rbed >		1
CONTENT % STRENGTH lbs./sq. ft. TECHNICIAN A. Augustyniak CHECKED BY C. Griffin		Shear Sh	i englii Vendisiai		1.(1	
					1.0	
COMMENTS Increased by 10% to 607 psf based on Bjerrum's Correction Factor.	SENSIVITY =	Shear St	rength (remole	ded) HALF - UNCONFI	NED COMPREH	
	SENSIVITY = NATURAL WA	Shear St	rength (remote	HALF - UNCONFII STRENGTH	NED COMPREH	1.

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TION:	llen Park, Mic	higan	DATI	E: 1/14/89	S-Account of the Control of the Cont
	FIEL	D VANE SHEA	R TEST REPO	RT	
TEST NO.		VS-3	ELEV. TOP OF HO	LE	594.7
BORING HOLE	NO		DEPTH TO TEST	POINT	40.0'
LINK & STA.	***************************************		ELEV. OF TEST		554.7
OFFSET	endethicken met kinde med it held (1994) (1994)	WE 440	(Tip of Van		
		VANE	DATA		
TORQUE ARM L	STH. $\frac{12}{}$ IN.	<u> </u>			
VANE LGTH. 3 VANE DIA. 2	3.5 IN. 2.0 IN.		7		
	AR STRENGTH	(s) = 5.17	_ x APPLIED TOF	RQUE (T) (in — lbs.)	. — Ibs.)
FRICTION ON V	ANE SHAFT	UNDISTURBED	CONDITION	REMOLDED	
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Rotation degrees	Force Gage Reading (lb
		30	9.0	30.	5.5
		35	9.1	35	6.0
'	1				
	45 45	40	9.1	40	6.0
		40 45	9.1	40 45	6.0 5.9
	 CALCULATIONS	45	9.1		5.9
READINGS &		45	9.1	45 NDISTURBED	5.9
READINGS &	CE GAGE REA	45 S	9.1 U	45 NDISTURBED CONDITION	5.9 REMOLDEI CONDITION
READINGS & MAXIMUM FOR	CE GAGE REA	45 Significant distribution of the second distri	9.1 U	45 NDISTURBED CONDITION 9.1	5.9 REMOLDEI CONDITION 6.0
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE	CE GAGE REA CE GAGE REA (lbs.)	45 DINGS for VANE DINGS for SHAF	9.1 (lbs.)	45 NDISTURBED CONDITION 9.1 . 9.1	5.9 REMOLDET CONDITION 6.0 6.0
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TOR	CE GAGE REA CE GAGE REA (lbs.) Que (t) = Net	45 DINGS for VANE DINGS for SHAF	9.1 (ibs.) T (ibs.)	45 NDISTURBED CONDITION 9.1	5.9 REMOLDET CONDITION 6.0
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TOR	CE GAGE REA (Ibs.) QUE (T) = NET	45 DINGS for VANE DINGS for SHAF FORCE x TORQUE H (S) = 1 Ar	9.1 (ibs.) T (ibs.) E ARMS (inibs.)	45 NDISTURBED CONDITION 9.1 . 9.1	5.9 REMOLDET CONDITION 6.0 6.0
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TOR	CE GAGE REA (Ibs.) Que (T) = NET HEAR STRENGT	45 DINGS for VANE DINGS for SHAF FORCE x TORQUE H (S) = 1 Ar	9.1 (ibs.) (lbs.) ARMS (inlbs.) T rbed) = 1	45 NDISTURBED CONDITION 9.1 9.1 109.2	5.9 REMOLDET CONDITION 6.0 6.0 72
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TOR ULTIMATE SH SENSIVITY =	CE GAGE REA (Ibs.) QUE (T) = NET HEAR STRENGT Shear St VATER	45 DINGS for VANE DINGS for SHAF FORCE x TORQUE H (S) = 1 Ar rength (undistu	9.1 (ibs.) (lbs.) ARMS (inlbs.) T rbed) = 1	45 NDISTURBED CONDITION 9.1 9.1 109.2 565 .51 NED COMPREH	5.9 REMOLDEI CONDITION 6.0 6.0 72 374
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TOR ULTIMATE SH SENSIVITY = NATURAL V CONTENT	CE GAGE REA (Ibs.) QUE (T) = NET HEAR STRENGT Shear St VATER	45 DINGS for VANE DINGS for SHAF* FORCE x TORQUE H (S) = 1 Ar rength (undisturength (remole	9.1 (ibs.) (ibs.) E ARMS (inibs.) T rbed) ded) HALF-UNCONFIN	45 NDISTURBED CONDITION 9.1 . 9.1 . 9.1 . 109.2 . 565 . 51 NED COMPREH Libs. / sq. 1	5.9 REMOLDET CONDITION 6.0 6.0 72 374 ENSIVE

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TEST NO. BORING HOLE N	n Park, Michi FIEL	gan D VANE SHEA	ROJECT NAME: _ DATI	Allen Park C E: 1/14/89	lay Mine		
TEST NO. BORING HOLE N	FIEL						
BORING HOLE N		<u>D VANE SHEA</u>			700-1		
BORING HOLE N							
INK & STA.	10		ELEV. TOP OF HO		594.7 50.0'		
_,	Bonne note no.						
	OFFSET (Tip of Vane)						
		VANE	DATA				
TORQUE ARM LG	TH. 12 IN.						
VANE LGTH. 3 VANE DIA. 2	.5 IN. .0 IN.			, 7			
ULTIMATE SHEA	R STRENGTH	(S) = 5.17	x APPLIED TOF	QUE (T) (in	. — Ibs.)		
	/ sq. ft.)		(in.	- lbs.)			
FRICTION ON VA	NE SHAFT	UNDISTURBED	CONDITION	REMOLDED	CONDITION		
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.)		
	cor so	85	12.9	45.	7.8		
		90	12.9	50	8.0		
		95	13.0	55	8.0		
		100	13.0	60	7.9		
READINGS &	CALCULATIONS	3	Ù	NDISTURBED CONDITION	REMOLDED CONDITION		
MAXIMUM FORCE	E GAGE REA	DINGS for VANE		13.0	8.0		
		DINGS for SHAFT					
		Diffee for entre	(1201)	40 to			
NET FORCE (-		:	13.0	8.0		
APPLIED TORQ	UE (T) = NET I	FORCE x TORQUE	ARMS (inIbs.)	156	96		
ULTIMATE SHE	EAR STRENGT	H (S) = Ar	- T	806	496		
SENSIVITY =		rength (undistu rength (remole	= = = = = = = = = = = = = = = = = = = =	1.6			
	ATER		HALF - UNCONFIN				
TECHNICIAN _	A. Augustyn	iak	CHECKED BY	C. Griffi	n		
COMMENTS	Increased	by 5% to 846 ps	f based on Bjer	rum's Correct:	ion Factor.		

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		NEYER, TISE	O & HINDO, LT	D.	
	2 OW en Park, Michi		ROJECT NAME:DAT	Allen Park Cla E: 1/16/89	ay Mine
	FIEL	D VANE SHEA	R TEST REPO	RT	
TEST NO.		VS-5	ELEV. TOP OF HO	LE	594.7
BORING HOLE NO. TB-3 DEPTH TO TEST POINT 60.0'					
LINK & STA.			ELEV. OF TEST	POINT	534.7
OFFSET	One or the second secon	400 —	(Tip of Va	16)	
TORQUE ARM LG		VANE	DATA		
	2.0 IN.	(S) = 5.17			. — Ibs.)
(lbs.	/ sq. ft.) ANE SHAFT	UNDISTURBED	(in.	- Ibs.)	CONDITION
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.)
		55	13.7	40.	7.7
		60	13.9	45	9.0
		65	13.9	50	9.0
		70	13.9	55	9.0
READINGS &	CALCULATIONS	1	<u> </u>	NDISTURBED CONDITION	REMOLDED CONDITION
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)	13.9	9.0
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	T (lbs.)	13.9	9.0
NET FORCE				13.9	9.0
APPLIED TORG	QUE (T) = NET	FORCE x TORQUE	ARMS (inlbs.)	166.8	108
ULTIMATE SH	EAR STRENGT	"H (S) =I Ar	- T	862	558
SENSIVITY =		rength (undistu rength (remole	T.	1.5	
NATURAL W	ATER %	6	HALF - UNCONFII STRENGTH		
TECHNICIAN _	A. Augustyn	iak	CHECKED BY	C. Griffi	n
COMMENTS	Increased	by 5% to 905 ps	f based on Bjer	rum's Correcti	on Factor.

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		NEYER, TISE	O & HINDO, LT	D.	
AFG: 116	612 OW en Park, Michi	gan Pi	ROJECT NAME:DAT	Allen Par E: 1/16/89	k Clav Mine
tion of Opening Management and Committee and	£121	D VANE CUEA	B TEST BEOK	D P	
TEST NO.		VS-6	ELEV. TOP OF HO		594.7
BORING HOLE NO. TB-3 DEPTH TO TEST POINT 70.0'					
LINK & STA. ELEV. OF TEST POINT 524.7					
OFFSET			(Tip of Va	ne)	
		VANE	DATA		
TORQUE ARM LO	STH. <u>12</u> IN.				
VANE LGTH VANE DIA					
ULTIMATE SHE	AR STRENGTH	(S) = 5.17	× APPLIED TO	RQUE (T) (in	. — Ibs.)
	/ sq. ft.)	4		— Ibs.)	
FRICTION ON V	ANE SHAFT	UNDISTURBED	CONDITION	REMOLDED	CONDITION
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Rotation degrees	Force Gage Reading (lbs.)
	42 ED	40	14.5	30	7.3
		45	14.9	35	8.1
		50	14.9	40	7.9
		55	14.8	45	7.8
READINGS 8	CALCULATIONS	8	U	NDISTURBED	REMOLDED
		······································	/14 - }	CONDITION	CONDITION
		DINGS for VANE		14.9	8.1
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	f (lbs.)	** **	65 10
NET FORCE	(lbs.)			14.9	8.1
APPLIED TOR	QUE (T) = NET	FORCE x TORQUE	ARMS (in lbs.)	178.8	97.2
ULTIMATE SH	IEAR STRENGT	TH (S) = I	- T	924	503
SENSIVITY =	Shear St	rength (undistu	rbed)	1.84	
SEIGIVIII	Shear St	rength (remole	ied)	1.07	
NATURAL W	/ATER	6	HALF - UNCONFIL STRENGTH		
TECHNICIAN	A. Augustyni	iak	CHECKED BY	C. Griffi	n
COMMENTS _	No increas	e needed per Bj	errum's Correct	ion Factor.	
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	FIEL	D VANE SHEA	R TEST REPO	RT	
TEST NO.	, NO. 100 100 100 100 100 100 100 100 100 10	VS-7	ELEV. TOP OF HO)LE	594.7
BORING HOLE	(111111111111111111111111111111111111111	DEPTH TO TEST.		80.0'
LINK & STA.	***************************************	60 40·	ELEV. OF TEST		514.7
OFFSET			(Tip of Var	18 /	
TORQUE ARM LO	STH. ¹² IN.	VANE	DATA	177 T T T T T T T T T T T T T T T T T T	
VANE LGTH VANE DIA	3.5 IN. 2.0 IN.		77.7	÷ 7	
(lbs.	/ sq. ft.)			- lbs.)	
FRICTION ON V		UNDISTURBED	CONDITION	REMOLDED	
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (16s.)	Rotation degrees	Force Gage Reading (II
	***	25	19.2	45	11.0
		_	20.0	50	11.0
		30	20.0		
		30 35	19.2	55	11.2
	 CALCULATIONS	35 40	19.2 19.2	55 60 INDISTURBED	11.2
 READINGS &	 CALCULATIONS	35 40 3	19.2 19.2	55 60 INDISTURBED CONDITION	11.2 REMOLDE CONDITION
READINGS &	 CALCULATIONS CE GAGE REA	35 40 S DINGS for VANE	19.2 19.2 (Ibs.)	55 60 INDISTURBED CONDITION 20.0	11.2 REMOLDE CONDITION 11.2
READINGS & MAXIMUM FOR	CALCULATIONS CE GAGE REA CE GAGE REA	35 40 3	19.2 19.2 (Ibs.)	55 60 INDISTURBED CONDITION 20.0	11.2 REMOLDE CONDITION 11.2
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE	CALCULATIONS CE GAGE REA CE GAGE REA	35 40 S DINGS for VANE DINGS for SHAF	19.2 19.2 (lbs.)	55 60 INDISTURBED CONDITION 20.0 20.0	11.2 REMOLDE CONDITION 11.2 11.2
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE	CALCULATIONS CE GAGE REA CE GAGE REA (lbs.) QUE (T) = NET I	35 40 S DINGS for VANE DINGS for SHAF	19.2 19.2 (lbs.) T (lbs.)	55 60 INDISTURBED CONDITION 20.0 20.0 240.0	11.2 REMOLDE CONDITION 11.2 11.2 134.4
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE	CALCULATIONS CE GAGE REA CE GAGE REA (Ibs.) QUE (T) = NET I	35 40 S DINGS for VANE DINGS for SHAF FORCE x TORQUIT TH (S) = Ar	19.2 19.2 (lbs.) T (lbs.) E ARMS (inibs.)	55 60 INDISTURBED CONDITION 20.0 20.0 240.0 1241	11.2 REMOLDE CONDITION 11.2 11.2
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE	CALCULATIONS CE GAGE REA CE GAGE REA (Ibs.) QUE (T) = NET I EAR STRENGT	35 40 S DINGS for VANE DINGS for SHAF FORCE x TORQUI TH (S) = 1 Ar rength (undistu	19.2 19.2 (lbs.) T (lbs.) E ARMS (inlbs.) — T	55 60 INDISTURBED CONDITION 20.0 20.0 240.0	11.2 REMOLDE CONDITION 11.2 11.2 134.4
READINGS & MAXIMUM FOR MAXIMUM FOR NET FORCE APPLIED TORO ULTIMATE SH SENSIVITY =	CALCULATIONS CE GAGE REA CE GAGE REA (Ibs.) QUE (T) = NET I BEAR STRENGT Shear St (ATER	35 40 S DINGS for VANE DINGS for SHAF FORCE x TORQUIT TH (S) = Ar	19.2 19.2 (lbs.) T (lbs.) E ARMS (inlbs.) — T	55 60 INDISTURBED CONDITION 20.0 20.0 240.0 1241 1.8	11.2 REMOLDE CONDITION 11.2 11.2 134.4 695

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			O & HINDO, LT		
ECT NO.: <u>8861</u> TION: Alle	2 OW n Park, MIchi	gan Pi	ROJECT NAME: _	Allen Par E: 1/17/89	k Clay Mine
(IION)					
	FIEL	D VANE SHEA	R TEST REPO	RT	
TEST NO.	-	TO 4	ELEV. TOP OF HO		594.0 25.0'
BORING HOLE		a namenon till at the state of	DEPTH TO TEST		569.0
LINK & STA. OFFSET			ELEV. OF TEST (Tip of Var	 "	003.0
TORQUE ARM LO	TH 12 IN.	VANE	DATA		
VANE LGTH VANE DIA	2.5_ IN.	(S) = 2.59	× APPLIED TO	POUF (T) (in	a — lhe)
	/ sq. ft.)	UNDISTURBED	CONDITION	- Ibs.)	
Rotation	Force Gage Reading (lbs.)		Force Gage Reading (1bs.)	Ratation	Force Gage Reading (lbs.
degrees	reading tips./	degrees 15	22.5	degrees .	8.0
		20	22.0	10	8.0
					1
	- ·	25	21.2	15	8.0
		30	19.2	NDISTURBED	8.0
READINGS &	CALCULATION	S	<u> </u>	CONDITION	CONDITION
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)	22.5	8.0
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	Γ (ibs.)	West 1980	
NET FORCE	(lbs.)			22.5	8.0
APPLIED TOR	QUE (T) = NET	FORCE x TORQUE	E ARMS (In Ibs.)	270	96.0
HI TIMATE SH	IEAR STRENGT	TH (S):	- T		
		rength (undistu		699	249
SENSIVITY =		rength (remole	2	0	
NATURAL W		/e	HALF - UNCONFIR		
B)				· · · · · · · · · · · · · · · · · · ·	
CONTENT.	A. August	yniak	CHECKED BY	C. Griff	in
TECHNICIAN		yniak .0% to 769 psf b			

		NEYER, TISE	O & HINDO, LT	D.	
OJECT NO.: 886	12 OW Michiga	P!	ROJECT NAME:	Allen Par	k Clay Mine
CATION: Allen	Park, Michiga	[QAT	E: 1/17/89	
	FIEL	D VANE SHEA	R TEST REPO	RT	
TEST NO.		VS-2	ELEV. TOP OF HO)LE	594.0
BORING HOLE	NO.	TB-4	DEPTH TO TEST.	POINT	35.0'
LINK & STA.	***************************************		ELEV. OF TEST	POINT	559.0
OFFSET			(Tip of Va	ne)	
		VANE	DATA		
TORQUE ARM L	GTH. <u>12</u> IN.				
VANE LGTH	4.5 IN. 2.5 IN.		******	7	
		(S) = 2.59		RQUE (T) (in — ibs.)	. — Ibs.)
FRICTION ON V	./sq. ft.) 	UNDISTURBED	CONDITION	REMOLDED.	CONDITION
Rotation degrees	Force Gage Reading (Ibs.)		Force Gage Reading (ibs.)	Rotation degrees	Force Gage Reading (lbs.)
		10	18	15	10
		1 F			
	700 ES	15	20	20	10
-		20	20	25	10
		25	20	30	10
READINGS &	CALCULATIONS	5	<u> </u>	INDISTURBED CONDITION	REMOLDED CONDITION
MAXIMUM FOR	RCE GAGE REA	DINGS for VANE	(lbs.)	20	10
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	(lbs.)		
NET FORCE				— 	
		, <u>, , , , , , , , , , , , , , , , , , </u>		20	10
APPLIED TOR	QUE (T) = NET	FORCE x TORQUE	ARMS (In Ibs.)	240	120
ULTIMATE SI	HEAR STRENGT	H (S) = Ar	- T	622	311
SENSIVITY =	Shear St Shear St	rength (undistu rength (remole	=2	.0	
NATURAL V	VATER	e transfe	HALF - UNCONFII STRENGTH		
TECHNICIAN	A. Augusty	niak	CHECKED BY	C. Griff	in
COMMENTS _	Increased by	7% to 666 psf b	pased on Bjerrum	ı's Correction	Factor.

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PROJECT NAME: Allen Park Clay Mine Allen Park Clay Mine Allen Park Allen Allen Park			NEYER TISE	O & HINDO, LT	·D	
TEST NO. VS-3	ECT NO.: 886 TION: Allen	12 NW Park, Michigan	PF	OJECT NAME:	Allen Park	Clav Mine
BORING HOLE NO. TB-4	COGOMENT A.	FIEL	D VANE SHEA	R TEST REPO	RT	
VANE LGTH. 4.5 IN. VANE DIA. 2.5 IN. ULTIMATE SHEAR STRENGTH (S) = 2.59 x APPLIED TORQUE (T) (In. — Ibs.) FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation Force Gage Reading (Ibs.) Gerres Faceding (Ibs.) 20 23 20 8.9 25 22.5 25 9.0 25 22.5 25 9.0 30 21.8 30 9.0 READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION MAXIMUM FORCE GAGE READINGS for VANE (Ibs.) 23.0 9.0 MAXIMUM FORCE GAGE READINGS for SHAFT (Ibs.) NET FORCE (Ibs.) 23.0 9.0 ULTIMATE SHEAR STRENGTH (S) = 1/4 T 7.15 280 SENSIVITY = Shear Strength (undisturbed) 2.6 NATURAL WATER CONTENT (Family Condition Conditi	BORING HOLE LINK & STA.	VS-3 TB-4		ELEV. TOP OF HODEPTH TO TEST.	POINT	45.0'
VANE LGTH. 4.5 IN. VANE DIA. 2.5 IN. ULTIMATE SHEAR STRENGTH (S) = 2.59 x APPLIED TORQUE (T) (In. — Ibs.) FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation Force Gage Reading (Ibs.) Gerres Faceding (Ibs.) 20 23 20 8.9 25 22.5 25 9.0 25 22.5 25 9.0 30 21.8 30 9.0 READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION READINGS & CALCULATIONS UNDISTURBED CONDITION CONDITION MAXIMUM FORCE GAGE READINGS for VANE (Ibs.) 23.0 9.0 MAXIMUM FORCE GAGE READINGS for SHAFT (Ibs.) NET FORCE (Ibs.) 23.0 9.0 ULTIMATE SHEAR STRENGTH (S) = 1/4 T 7.15 280 SENSIVITY = Shear Strength (undisturbed) 2.6 NATURAL WATER CONTENT (Family Condition Conditi			VANE	DATA		
ULTIMATE SHEAR STRENGTH (S) = 2.59 x APPLIED TORQUE (T) (In. — Ibs.) (Ibs. / sq. ft.) FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation force Gage Reading (Ibs.) ———————————————————————————————————	TORQUE ARM LO	этн. <u>12</u> і п.				
FRICTION ON VANE SHAFT UNDISTURBED CONDITION REMOLDED CONDITION Rotation Force Gage Reading (lbs.) Force Gage Reading (lbs.) Regarding (lbs.) Reading (lbs.					7	
Rotation degrees Reading (lbs.) Rotation degrees Reading (lbs.) 20 23 20 8.9 25 22.5 25 9.0 30 21.8 30 9.0 35 21.8 35 9.0 READINGS & CALCULATIONS MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for VANE (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = i T 715 280 SENSIVITY = Shear Strength (remaided) NATURAL WATER CONTENT (Bs.) NATURAL WATER CONTENT (C. Griffin) TECHNICIAN A. Augustyniak CHECKED BY C. Griffin	(!bs.	/ sq. ft.)		(in.	. — Ibs.)	
Content Cont						•
		Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Rotation degrees	Force Gage Reading (lbs
30 21.8 30 9.0 35 21.8 35 9.0 READINGS & CALCULATIONS UNDISTURBED CONDITION MAXIMUM FORCE GAGE READINGS for VANE (lbs.) 23.0 9.0 MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) 23.0 9.0 APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) 276 108 ULTIMATE SHEAR STRENGTH (S) = 1 T 715 280 SENSIVITY = Shear Strength (undisturbed) 2.6 Shear Strength (remoided) NATURAL WATER CONTENT % STRENGTH Ibs./ sq. ff. TECHNICIAN A. Augustyniak CHECKED BY C. Griffin			20	23	20 .	8.9
READINGS & CALCULATIONS MAXIMUM FORCE GAGE READINGS for VANE (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) SENSIVITY = Shear Strength (undisturbed) Shear Strength (remoided) NATURAL WATER CONTENT A. Augustyniak CHECKED BY CONDITION REMOLD CONDITION CO			25	22.5	25	9.0
READINGS & CALCULATIONS MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inlbs.) SENSIVITY = Shear Strength (undisturbed) Shear Strength (remoided) NATURAL WATER CONTENT A. Augustyniak CHECKED BY CONDITION REMOLD CONDITION CONDITION REMOLD CONDITION CONDITION 9.0 108 108 108 108 108 108 108 1			30	21.8	30	9.0
MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = T		460 660	35	21.8	35	9.0
MAXIMUM FORCE GAGE READINGS for VANE (lbs.) MAXIMUM FORCE GAGE READINGS for SHAFT (lbs.) NET FORCE (lbs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inlbs.) ULTIMATE SHEAR STRENGTH (S) =i	READINGS &	CALCULATIONS	3	}	UNDISTURBED CONDITION	REMOLDED
NET FORCE (Ibs.) APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) =i	MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)		9.0
APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = i T 715 280 SENSIVITY = Shear Strength (undisturbed) = 2.6 Shear Strength (remoided) NATURAL WATER HALF-UNCONFINED COMPREHENSIVE STRENGTH Ibs. / sq. ft. TECHNICIAN A. Augustyniak CHECKED BY C. Griffin	MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	(1bs.)		
APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (inibs.) ULTIMATE SHEAR STRENGTH (S) = i	NET FORCE	(lbs.)			23.0	9.0
ULTIMATE SHEAR STRENGTH (S) = T	APPLIED TORG	QUE (T) = NET I	FORCE x TORQUE	ARMS (in lbs.)		
SENSIVITY: Shear Strength (undisturbed) 2.6 Shear Strength (remolded) NATURAL WATER	ULTIMATE SH	EAR STRENGT	'H (S) = 1	- т		
CONTENT% STRENGTHIbs./sq. ft. TECHNICIAN A. Augustyniak CHECKED BY C. Griffin	SENSIVITY =		rength (undistu	\$		
		ATER				
	TECHNICIAN _	A. Augustyn	îak	CHECKED BY	C. Griffin	
COMMENTS Increased by 5% to 750 psf based on Bjerrum's Correction Factor.	COMMENTS	Increased by	5% to 750 psf b	ased on Bjerrun	n's Correction	Factor.

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NTION: All	612 OW en Park, Mich		ROJECT NAME: _ DAT	Allen Park C E: 1/18/89	lay Mine
	FIEL	D VANE SHEA	R TEST REPO)RT	
TEST NO. BORING HOLE I LINK & STA. OFFSET		VS-4 TB-4	ELEV. TOP OF HODEPTH TO TEST. ELEV. OF TEST	POINT	594.0 55.0 539.0
	ya kata a sana a sa	VANE	DATA		
TORQUE ARM LG	TH. 12 IN.				
VANE LGTH. 4			*****). 7	
(lbs.	/ sq. ft.)	(S) = 2.59	(in.	. — Ibs.)	
FRICTION ON VA		UNDISTURBED Rotation	CONDITION Force Gage	REMOLDED Rotation	
degrees	Force Gage Reading (lbs.)	degrees	Reading (1bs.)	degrees	Force Gage Reading (lbs.
		10	14.1	10	6.2
	** ***	15	18.0	15	6.5
	· <u> </u>			1	5
		20	18.0	20	6.2
		20 25	17.0	25	6.0
		25	17.0		
 READINGS &	 CALCULATIONS	25	17.0	25 JNDISTURBED	6.0
READINGS &	CALCULATIONS	25 S	17.0	25 JNDISTURBED CONDITION	6.0 REMOLDED CONDITION
READINGS &	CALCULATIONS CE GAGE REA CE GAGE REA	25 S DINGS for VANE	17.0	25 JNDISTURBED CONDITION 18.0	6.0 REMOLDED CONDITION 6.5
READINGS & MAXIMUM FORCE NET FORCE (CALCULATIONS CE GAGE REA CE GAGE REA Ibs.)	25 S DINGS for VANE	17.0 (!bs.)	25 JNDISTURBED CONDITION 18.0	6.0 REMOLDED CONDITION 6.5
READINGS & MAXIMUM FORCE NET FORCE (CALCULATIONS CE GAGE REA CE GAGE REA Ibs.)	25 DINGS for VANE DINGS for SHAFT	17.0 (!bs.)	25 JNDISTURBED CONDITION 18.0 18.0	6.0 REMOLDED CONDITION 6.5 6.5
READINGS & MAXIMUM FORCE NET FORCE (APPLIED TORCE	CALCULATIONS CE GAGE REA Ibs.) DUE (T) = NET EAR STRENGT	25 DINGS for VANE DINGS for SHAFT	17.0 (ibs.) (ibs.) ARMS (inlbs.) T	25 JNDISTURBED CONDITION 18.0 18.0 216.0	6.0 REMOLDED CONDITION 6.5 6.5 78.0
READINGS & MAXIMUM FORCE MAXIMUM FORCE NET FORCE (APPLIED TORCE ULTIMATE SHI SENSIVITY =	CALCULATIONS CE GAGE REA LE GAGE REA LIbs.) DUE (T) = NET LE EAR STRENGT Shear Strengt Shear Strengt	25 DINGS for VANE DINGS for SHAFT FORCE x TORQUE TH (S) = 1 Ar rength (undistu	17.0 (ibs.) (ibs.) ARMS (inlbs.) T	25 JNDISTURBED CONDITION 18.0 18.0 216.0 559 2.8 NED COMPREH	6.0 REMOLDED CONDITION 6.5 6.5 78.0 202
READINGS & MAXIMUM FORCE MAXIMUM FORCE NET FORCE (APPLIED TORCE ULTIMATE SHI SENSIVITY = NATURAL W CONTENT	CALCULATIONS CE GAGE REA LE GAGE REA LIbs.) DUE (T) = NET L EAR STRENGT Shear St ATER	25 DINGS for VANE DINGS for SHAFT FORCE x TORQUE TH (S) = 1 Ar rength (undisturted)	17.0 (Ibs.) (Ibs.) ARMS (in - Ibs.) Tribed) ded) HALF - UNCONFI	25 JNDISTURBED CONDITION 18.0 18.0 216.0 559 2.8 NED COMPREH Ibs. / sq. 1	6.0 REMOLDED CONDITION 6.5 6.5 78.0 202 ENSIVE

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	ere i	D VANE SHEA	R TEST REPO	RY	TANKS PARTIES AND		
TEST NO.			ELEV. TOP OF HO		594.0		
BORING HOLE N			DEPTH TO TEST		65.0'		
LINK & STA.			ELEV. OF TEST	POINT	529.0		
OFFSET			(Tip of Van	•)			
TORQUE ARM LG		VANE	DATA				
	.5_ IN.	(S) * 2.59	x APPLIED TOP		. — (bs.)		
FRICTION ON VA	/ sq. ft.)	UNDISTURBED	CONDITION	- Ibs.)	CONDITION		
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (Ib		
		5	5	10	7.0		
		10	7.0	15	7.5		
		15	7.0	20	7.0		
	·	20	7.0	25	7.0		
READINGS &	CALCULATIONS		U	NDISTURBED CONDITION	REMOLDED		
	E GAGE REAL	DINGS for VANE	(Ibs.)	7.0	7.5		
MAXIMUM FORC	E GAGE REAL	DINGS for SHAFT	(lbs.)		es 		
		<u>, , , , , , , , , , , , , , , , , , , </u>		7.0	7.5		
MAXIMUM FORC	lbs.)	NET FORCE (Ibs.)					
MAXIMUM FORCE (FORCE x TORQUE	ARMS (in lbs.)	Ω/I			
MAXIMUM FORCE (UE (T) = NET F	(6)	ARMS (in lbs.)	84 218*	233*		
MAXIMUM FORCE (APPLIED TORQ	UE (T) = NET F EAR STRENGT Shear Str	$H(S) = \frac{1}{Ar}$	T T	84 218* 0.93	233*		
MAXIMUM FORCE (NET FORCE (APPLIED TORQ ULTIMATE SHE SENSIVITY =	UE (T) = NET F EAR STRENGT Shear Str	H (S) = l Ar rength (undistur	T T	218* 0.93	ENSIVE		
MAXIMUM FORCE (NET FORCE (APPLIED TORQ ULTIMATE SHE SENSIVITY =	UE (T) = NET F EAR STRENGT Shear Str Shear Str ATER	H (S) = Ar rength (undistuinength (remote	Tribed)	218* 0.93 IED COMPREH bs./sq. 1	ENSIVE		

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NEYER, TISEO & HINDO, LTD. PROJECT NO:___ 88612 OW __ PROJECT NAME: ___ Allen Park Clay MIne Allen Park, Michigan 1/18/89 LOCATION: DATE: FIELD VANE SHEAR TEST REPORT TEST NO. VS-6 ELEV. TOP OF HOLE 594.0 75.0' BORING HOLE NO. TB-4 DEPTH TO TEST POINT 519.0 LINK & STA. ELEV. OF TEST POINT ___ OFFSET (Tip of Vane) DATA VANE TORQUE ARM LGTH. 12 IN. VANE LGTH. 4.5 IN. VANE DIA. 2.5 IN. ULTIMATE SHEAR STRENGTH (S) = 2.59 x APPLIED TORQUE (T) (in. - 1bs.) (lbs. / sq. ft.) (in. - lbs.) FRICTION ON VANE SHAFT UNDISTURBED REMOLDED. CONDITION CONDITION Force Gage Reading (Ibs.) Force Gage Reading (lbs.) Force Gage Reading (lbs.) Rotation Rotation Ratation degrees degrees degrees 19.0 10 15 15 17.5 20 15 19.5 20 18 25 19.0 30 18.5 REMOLDED CONDITION UNDISTURBED READINGS & CALCULATIONS CONDITION MAXIMUM FORCE GAGE READINGS for VANE (Ibs.) 18 19.5 MAXIMUM FORCE GAGE READINGS for SHAFT (1bs.) NET FORCE (Ibs.) 18 19.5 APPLIED TORQUE (T) = NET FORCE x TORQUE ARMS (in.-ibs.) 216 234 ULTIMATE SHEAR STRENGTH (S) = T 559 606 Shear Strength (undisturbed) 0.92 SENSIVITY . Sheor Strength (remoided) NATURAL WATER HALF-UNCONFINED COMPREHENSIVE CONTENT_ STRENGTH. ibs. / sq. ft. A. Augustyniak C. Griffin TECHNICIAN ____ __CHECKED BY _____ **COMMENTS** <u>During</u> undisturbed test casing started turning. Test ended. During remolding pipe wrench was secured to prevent casing from moving.

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CT NO.: 88	olz uw Park, Michiga		ROJECT NAME: _	Allen Park Cl E: 1/19/89		
					Maria de la compania	
and the second s	<u> </u>		R TEST REPO			
TEST NO.	<u>VS-1</u>		ELEV. TOP OF HO		53.2	
BORING HOLE	NO. TB-5		DEPTH TO TEST		.5.0 8.20	
LINK & STA. OFFSET			ELEV. OF TEST (Tip of Var		0.20	
	GREGORIA GEOGRAPHICA SE CONTROL DE CONTROL D		*			
TORQUE ARM LO	TH. 12 IN.	VANE	DATA			
VANE LGTH VANE DIA			*****	7		
	/ sq. ft.)	(S) = 5.17	(in.	— Ibs.)		
Rotation ON V		UNDISTURBED Rotation	CONDITION	REMOLDED Rotation		
degrees	Force Gage Reading (Ibs.)	degrees	Force Gage Reading (lbs.)	degrees .	Force Gage Reading (Ib	
		20	3.2	10.	1.8	
		25	3.2	15	2.0	
		30	3.2	20	2.0	
	400 etc	35	3.2	25	2.0	
READINGS &	CALCULATIONS	3		NDISTURBED	REMOLDED	
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(the)	CONDITION	CONDITION	
		DINGS for SHAFT		3.2	2.0	
		DINGS TOT STAFT	1 (103.7			
NET FORCE	·			3.2	2.0	
APPLIED TORG	QUE (T) = NET I	FORCE x TORQUE	ARMS (in ibs.)	38.4	24.0	
ULTIMATE SH	EAR STRENGT	'H (S) =	- T	198	124	
SENSIVITY =	***************************************	rength (undistu		1.6		
		rength (remote				
NATURAL W CONTENT.	/ATER 	6	HALF - UNCONFIN	NED COMPREH Ibs./sq. 1		
	A. August		CHECKED BY			
AA		<u>ult indicates d</u>	المنتسب مستنمس الملها	oup m-1f + '		

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			O & HINDO, LT					
JECT NO :886		Pi	ROJECT NAME:		ay Mine			
ATION: AT	ien Park, Mici	ligari	DAT	E: 1/19/89				
	FIEL	D VANE SHEA	R TEST REPO	RT				
TEST NO.			ELEV. TOP OF HO		563.2			
BORING HOLE			DEPTH TO TEST		25.0			
LINK & STA.	Contraction of the last of the	P 129	ELEV. OF TEST	POINT	538.2			
OFFSET		· =	(Tip of Var	ne)				
		VANE	DATA					
TORQUE ARM L	GTH. <u>12</u> IN.							
VANE LGTH VANE DIA	3.5 IN. 2.0 IN.		***	, 7				
ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) (in Ibs.) (in Ibs.)								
FRICTION ON V	ANE SHAFT	UNDISTURBED CONDITION		REMOLDED	CONDITION			
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Rotation degrees	Force Gage Reading (lbs.)			
		10	5.0	5	1.0			
		15	5.5	10	1.0			
		20	5.0	15	1.0			
		25	5.0	20	1.0			
READINGS &	CALCULATIONS	3	V	NDISTURBED CONDITION	REMOLDED CONDITION			
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)	5.5	1.0			
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	「(lbs.)					
			i					
NET FORCE				5.5	1.0			
APPLIED TOR	QUE (T) = NET	FORCE x TORQUE	ARMS (inibs.)	66.0	12.0			
ULTIMATE SH	HEAR STRENGT	"H (S) = - Ar	- т	341 *	62.1			
CENCIVIES -	Shear St	rength (undistu	rbed)	5.5				
SENSIVITY =	Shear St	rength (remole	ded)	J. J				
NATURAL V		6	HALF - UNCONFIN					
TECHNICIAN .	A. Augustyni	iak	CHECKED BY	C. Griffi	n			
COMMENTS _	*Low test resu	ılt indicates di	al gauge may ha	ve malfunction	ed.			
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			0 & HINDO, LT						
JECT NO.: 886	12 OW len Park, Mich	igan Pi	ROJECT NAME:	4 (00 (00	<u>ny Mine</u>				
ATION: AT	TCIF I GIT & FIFE II	Tyun	UA1	E: 1/20/89	and the same of th				
	FIEL	D VANE SHEA	R TEST REPO	RT					
TEST NO.	V	S-3 (ELEV. TOP OF HO)LE	563.2				
BORING HOLE	NO	B-5	DEPTH TO TEST	POINT	35_0				
LINK & STA.		ELEV. OF TEST		528.2					
OFFSET	-		(Tip of Va	10)					
		VANE	DATA						
TORQUE ARM L		<u> </u>							
VANE LGTH	3.5 IN. 2.0 IN.			,					
	Economic State of the Control of the			7					
			/						
ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) (in Ibs.) (ibs. / sq. ft.) (in Ibs.)									
FRICTION ON V	ANE SHAFT	UNDISTURBED	CONDITION	REMOLDED	CONDITION				
Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (1bs.)	Ratation degrees	Force Gage Reading (lbs.)				
		20	3.0	35.	3.0				
		25	3.0	40	3.0				
~ =	. Res sec	30	3.0	45	3.0				
		35	3.0	50	3.0				
READINGS &	CALCULATIONS	3		INDISTURBED CONDITION	REMOLDED				
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)	3.0	3.0				
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	Γ (lbs.)						
NET FORCE	(lbs.)			3.0	3.0				
APPLIED TOR	QUE (T) = NET	FORCE x TORQUE	ARMS (inlbs.)	36	36				
	IEAR STRENGT		- T	186*	186				
		rength (undistu	rbed)		1100				
SENSIVITY :	Shear St	***	=	1.0					
	/ATER		HALF - UNCONFI						
CONTENT	9	4	STRENGTH	lbs./sq.	TT.				
TECHNICIAN .	A. Augustyr	niak	CHECKED BY	C. Griffin					
COMMENTS _	*Low test res	ult indicates d	ial gauge may h	ave malfunctio	oned.				
4									

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JECT NO.: 886	12 OW		O & HINDO, LT		av Mine				
ATION: Allen	Park, Michiga	Λ		E: 1/20/89					
	FIEL	D VANE SHEA	R TEST REPO	RT					
TEST NO.		S-4 I	ELEV. TOP OF HO	LE	563.2				
BORING HOLE	2		DEPTH TO TEST	POINT	45.0'				
LINK & STA.	<u> </u>		ELEV. OF TEST		518.20				
OFFSET			(Tip of Vai	10)					
		VANE	DATA	(2)(p)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)					
VANE LGTH VANE DIA	3.5 IN.		*****	÷ 7	•				
ULTIMATE SHEAR STRENGTH (S) = 5.17 x APPLIED TORQUE (T) (in lbs.) (lbs./sq. ft.) (in lbs.)									
FRICTION ON V		UNDISTURBED	CONDITION	REMOLDED					
Rotation degrees	Force Gage Reading (Ibs.)	Rotation degrees	Force Gage Reading (lbs.)	Rotation degrees	Force Gage Reading (lbs.				
	w es	20	7.0	10.	2.0				
		25	7.5	20	2.0				
er =	- –	30	7.5	25	2.0				
		35	7.0	30	2.0				
READINGS &	CALCULATIONS	3	<u> </u>	NDISTURBED CONDITION	REMOLDED CONDITION				
MAXIMUM FOR	CE GAGE REA	DINGS for VANE	(lbs.)	7.5	2.0				
MAXIMUM FOR	CE GAGE REA	DINGS for SHAFT	r (Ibs.)		<u> </u>				
NET FORCE	(lbs.)			7.5	2.0				
APPLIED TORG	DUE (T) = NET I	FORCE x TORQUE	ARMS (inibs.)	90	24				
	EAR STRENGT	<u> </u>	- T						
OLIMAIE SH	·	rength (undistu	had)	465	124				
SENSIVITY =	***************************************	rength (remole		.7					
NATURAL W	ATER	6	HALF - UNCONFII STRENGTH						
TECHNICIAN _	A. Augustyni	ak	CHECKED BY						
COMMENTS _	No increas	e needed per Bj	errum's Correct	ion Factor.	Allen Books (Alen Book) (A				
		manananan — <u>— — — — — — — — — — — — — — — — — —</u>	مىدادىدىنىيىلىكى ئىلىدادەت بىلىدىنىيىنىيىتىن بىلىدىنىيىلىكى بىلىدىنىيىتىن بىلىدىن بىلىدىن بىلىدىن بىلىدىن بىلى ئىلىدىنىيىلىكى بىلىدىن						

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PROJEC	TNO. 8	38612 AV	V		-	NE	YER,	TISEO & HINDO	, LT	D.						SHEE	т 1	OF	2	
							TABUL	ATION OF TEST DATA	١											
				·					Po	ırtic	le Si	ze D	istri	buti	on	A†† Li	erber mits	9		
Test Boring or Test Pit Number	Sample Number	Depth of Sample Tip	Elevation of Sample Tip	Unconfined Compressive Strength (PSF)	Failure Strain (Percent)	Natural Water Content (Percent of Dry Weight)	In—Place Dry Density (Pounds per Cubic Foot)	Permeability (Centimeters per Second)	Colloids (Percent)	Clay (Percent)	Silt (Percent)	Fine Sand (Percent)	Medium Sand (Percent)	Coarse Sand (Percent)	Gravel (Percent)	Liquid Limit (Percent)	Plastic Limit (Percent)	Plasticity Index (Percent)	Apparent Specific Gravity	Unified Soil Classification
TB- 3	PS-1T PS-1 PS-2 PS-3T PS-3 PS-4T PS-4 PS-5 PS-6T PS-6 PS-7	18.0 20.0 27.0 37.0 39.0 45.0 47.0 55.0 67.0 75.0	576.7 574.7 567.7 557.7 555.7 549.7 547.7 539.7 529.7 527.7 519.7	2070 2180 - 1500 1240 1690 1560 1420 1420 1420	11.2 14.3 - 15.0 15.0 15.0 15.0 14.5 15.0	24.2 21.5 17.6 18.1 18.3 19.8 19.4 19.6 23.2 22.7 24.3	103.5 110.2 116.7 116.5 114.6 106.8 111.5 112.3 105.5 104.7 109.3	- - - - - - - -		-	_ _ _ _ _				1 1 1 1 1 1	27 21 24 28 30 31 34	15 14 15 15 17 18	12 7 9 13 13 13		CL CL CL CL CL CL
TB 4	S-2 PS-1 PS-2T PS-2 PS-3 PS-4T PS-4 PS-5 PS-6	15.0 20.0 30.5 32.5 40.0 50.0 52.0 62.0 70.0	579.0 574.0 563.5 561.5 554.0 544.0 542.0 532.0 524.0	2060 2230 1710 1350 1440 1430 1140 —	15.0 14.5 15.0 15.0 14.5 15.0 15.0	33.2 30.0 18.7 19.5 19.2 20.1 21.0 22.2 24.1	88.0 95.3 116.0 112.6 111.9 111.0 114.8 106.9 104.5	- - - - - - -		-		-	-			38 23 26 29 31 52	20 16 15 17 18 26	18 7 11 12 13 26	-	CL CL CL CH

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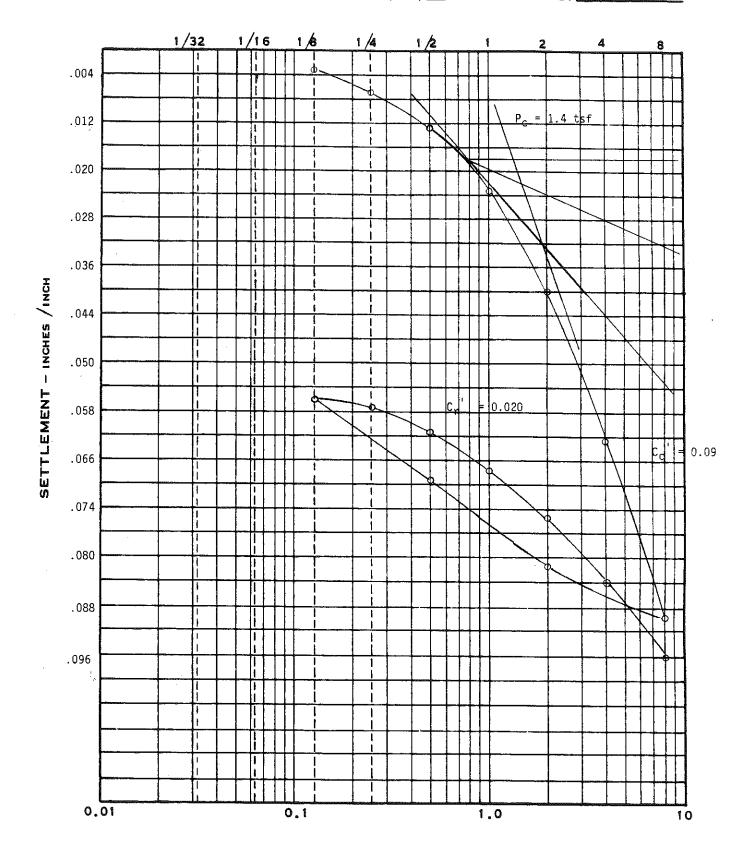
			Unitied Soil Classification	ರ ರ ರ ರ ಕ
2			Apparent Specific Gravity	1 1 1 1 1
OF.		σ.	Plasticity Index (Percent)	13 14 15 19 29
1 2		Atterberg Limits	Plastic Limit (Percent)	C C C C C C C C C C C C C C C C C C C
SHEET		Atte	(fnecreq) timid biupid	30 31 34 34 35 36 37 37 37 37 37 37 37 37 37 37 37 37 37
		r.	Gravel (Percent)	
		outic	Coarse Sand (Percent)	1 1 1 1 1
		istril	Medium Sand (Percent)	1 1 1 1 1
		Particle Size Distribution	Fine Sand (Percent)	1 1 1 1
		e Si	Silt (Percent)	1 1 1 1 1
D.		<u>:</u>	Clay (Percent)	1 1 1 1 1
LT		Р	Colloids (Percent)	
NEYER, TISEO & HINDO, LTD.	TABULATION OF TEST DATA		Permeability (Centimeters per Second)	
YER,	TABUL		In-Place Dry Density (Pounds per Cubic Foot)	109.1 111.2 104.4 108.7 100.3 84.8
NE			Natural Water Content (Percent of Dry Weight)	20.9 21.0 22.1 21.6 24.7 37.2
			Failure Strain (Percent)	19.0 19.3 15.0 15.0
			Unconfined Compressive Strength (PSF)	810 1000 - - 920
≥			Glevation of Sample Tip	552.7 543.2 534.7 523.2 514.2 508.2
88612 OW			Depth of Sample Tip	10.5 20.0 28.5 40.0 49.0 55.0
PROJECT NO.			Sample Number	PS-1 PS-2 PS-3 PS-5 SS-1
PROJE			Test Boring or Test Pit Number	18-5

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NEYER, TISEO & HINDO, LTD.

CONSOLIDATION TEST

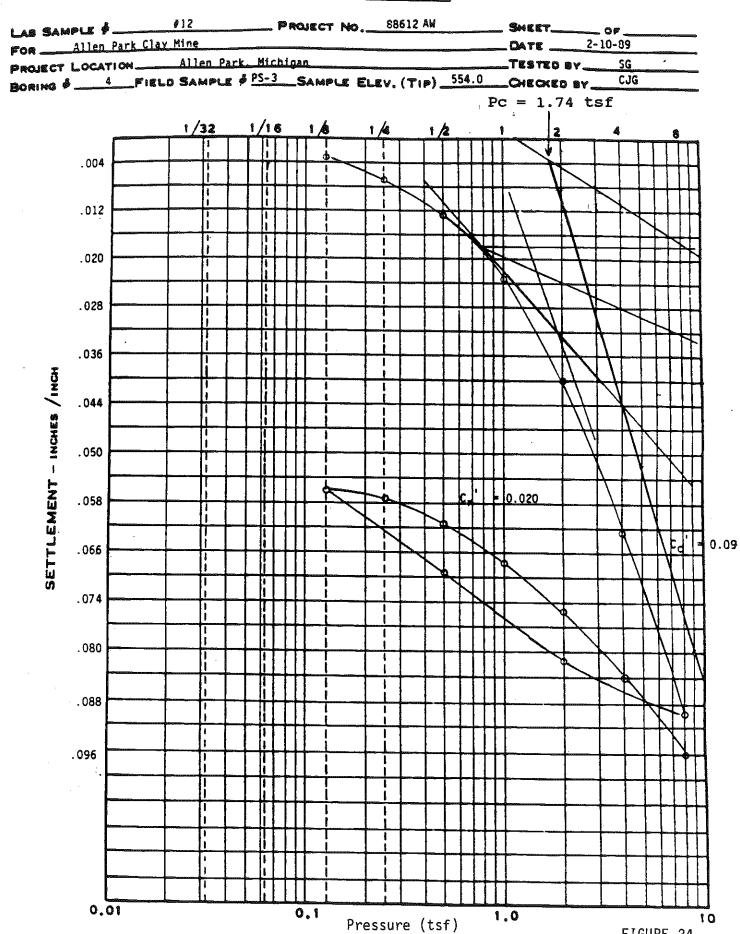
LAB SAMPLE # #12 PROJECT No. 88612 AW	SHEET OF
FORAllen Park Clay Mine	DATE
PROJECT LOCATION Allen Park, Michigan	TESTED BY SG
BORING # 4 FIELD SAMPLE # PS-3 SAMPLE ELEV. (TIP)	554.0 CHECKED BY CJG



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NEYER, TISEO & HINDO, LTD.

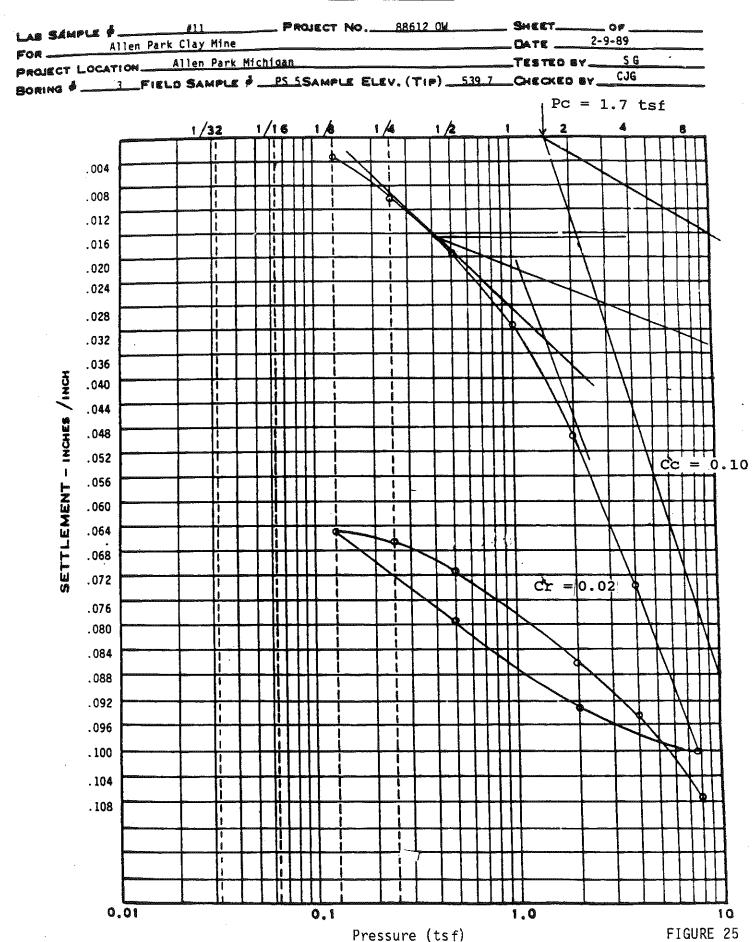
CONSCLIDATION TEST



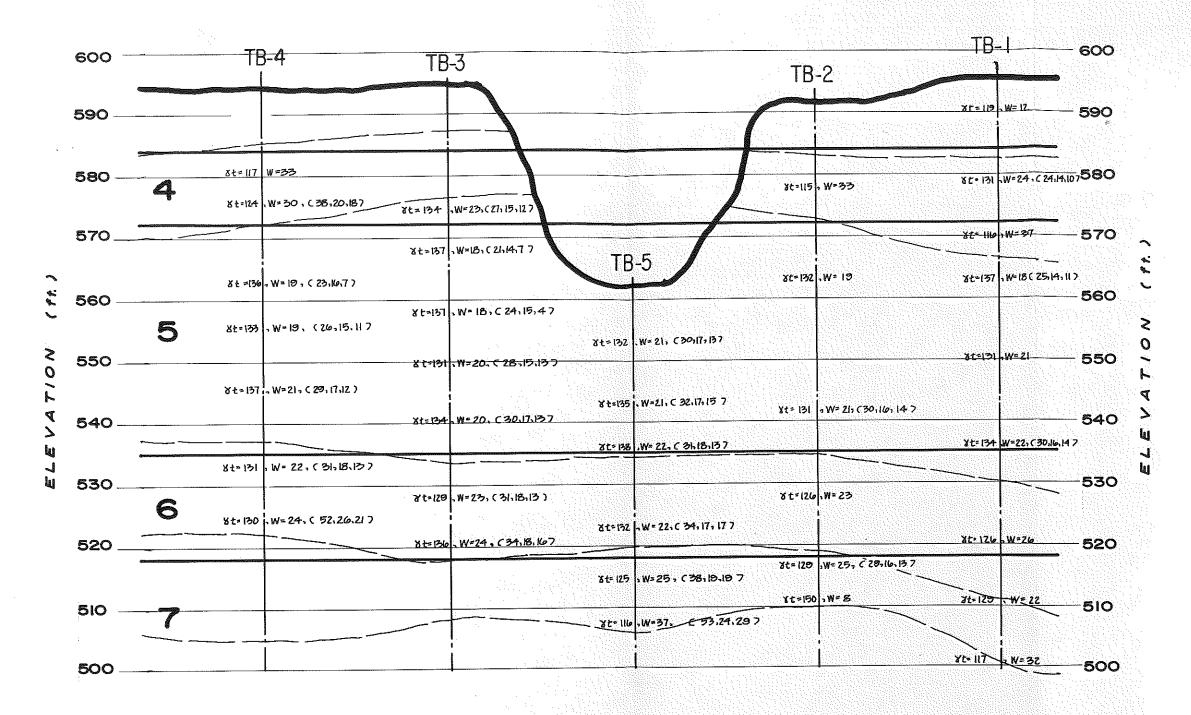
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NEYER. TISEO & HINDO, LTD.

CONSOLIDATION TEST



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NOTE: NO HORIZONITAL SCALE

LEGEND ESTIMATED ACTUAL SUBSURFACE ELEVATIONS DESIGN SUBSURFACE PROFILE ELEVATIONS LAYER DESIGNATIONS

SUMMARY OF SOIL INDEX PROPERTIES

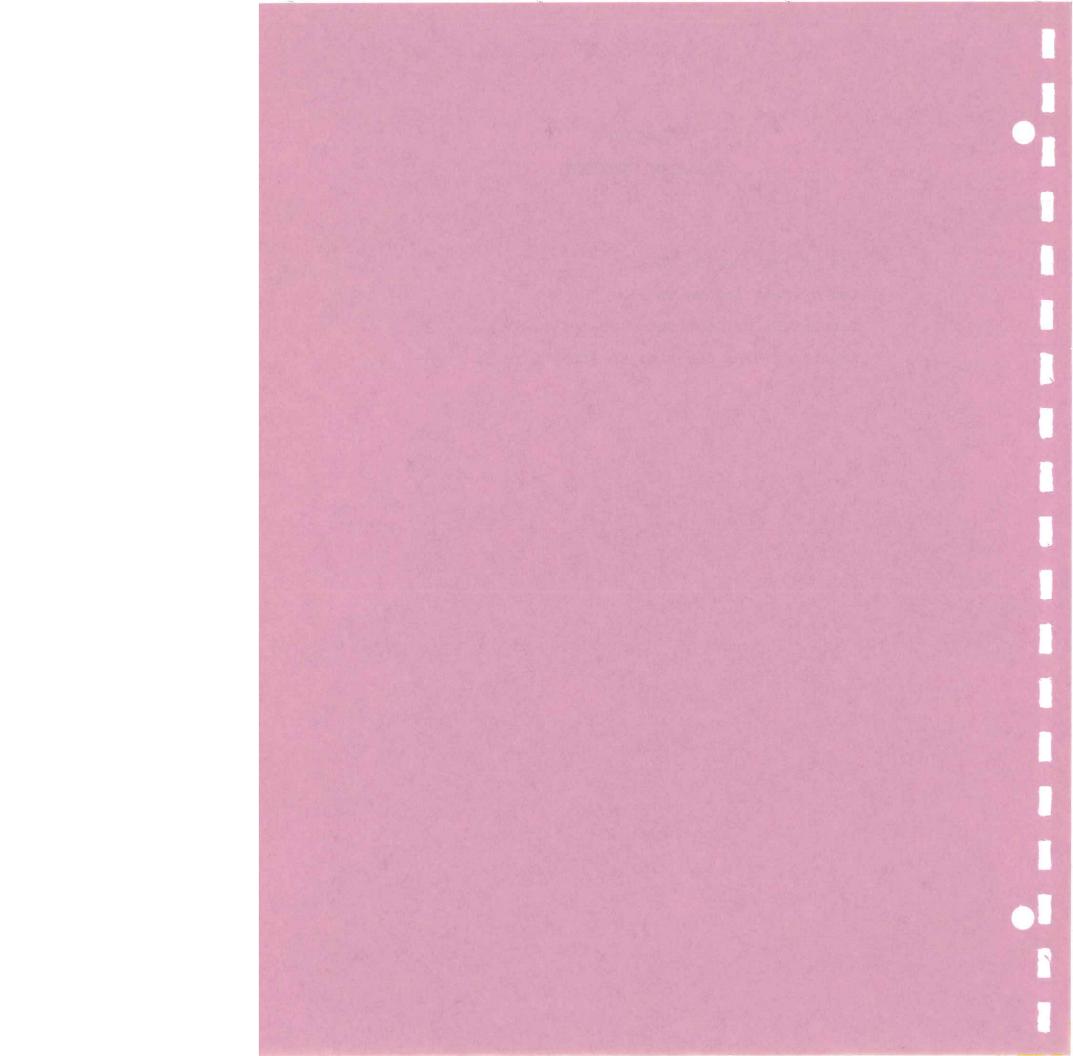
ALLEN PARK GLAY MINE LANDFILL HAZARDOUS CELL II ALLEN PARK MICHIGAN



NEYER, TISEO & HINDO, LTD. CONSULTING ENGINEERS AND GEOLOGISTS

38955 HILLS TECH DRIVE . FARMINGTON HILLS, MI 48018

PROJECT NO .: 88612 AW DRAWN BY: GUY DATE: 7-7-89 SCALE: Not to Scale CHECKED BY: LK SHEET I OF



LOG OF SUBSURFACE PROFILE		s a	 مفقی کا ا	B	
CLASSIFICATIONS BY:			MATURAL		APA
GROUND SURFACE ELEVATIONS 595.6	TAMPLE PLANCE	(FEET)	CONTENT	DENSITY	PENETRATION
//				((()	10 20 30 3
// with Wood, Wire, Brick, Concrete	LS-1			101.4	6-1-8
/1	LS-2	_585.6		9	1 1-6-6
111	LS-3	580.6		•	2.3-4
{{} }	LS-4	575.6		105.9	/ ₁ 1-1-2
团	LS-5	570.6	36.6	84.7	
∤∤	-		17.9	116,4	PUSHED
kN .		- 444 B	-	-	
	LS-6	555.6		•	11-2-3
Soft to Medium Gray SILTY CLAY	LS-7	550.6	21.1	107.9	1-2-3
with Trace of Sand.	<u>LS-8</u>	545.6			2-2-3
U	VS-Z	540.5	•	-	
1	25-3	535.1	7, الإ	1)0,3	40 ° 1) 1; 4)
 	\$-1	530.6			2-3-4
XI	12-1	5/3 6			444
}	LS-9	520.5	25.9	99.7	
	LS-10	515.6	•	•	2-8-4
	LS-11	510.6	21.7	106.2	5-8+11
	LS-12	505.6			4-5-6
***	LS-13	500.6	31.6	88.5	1 1 1 2 7 1
MOTES:	LS-14	495.6	NO RECOV	ERY 1	9-32-70/51
diameter solid-stem augers to 10 feet, and 3-7/8 inch diameter tricone roller bit with recirculating drilling fluid to bottom of hole. 4-inch diameter casing was driven to 12.5 feet. 2. Artesian water pressure was obe					
TAL DEPTH: 100.0	hardpan 1 2-inch 4	ayer.	No piezos	Metric le	vel was ob-
PINE COMPLEYED: 12/26/84 PECTON: L. Kendall/D. Vensel	on i topic	ig Hell	No. MW-1.		_
		CORS	OLTING E	MGINEERS	.
WATER LEVEL IN HOLE AT INDICATED					
THE THE PLANT IN PLANT.	AL				ILL
EMETRATION RESISTANCE.	W.				
12 mass, vains 140	APPROVES				11/85
	Soft to Medium Gray SILTY CLAY with Trace of Sand. Soft to Medium Gray SILTY CLAY with Trace of Sand. Soft to Medium Gray SILTY CLAY with Trace of Sand. Soft to Medium Gray SILTY CLAY with Trace of Sand. NOTES: 1. Borings advanced using 4-inch diameter solid-stem augers to 10 feet, and 3-7/8 inch diameter tricone roller bit with rectr- culating drilling fluid to bottom of hole. 4-inch diameter casing was driven after pressure was ob- served after pressure. 2. Aresida water pressure was ob- served. 12/19/84 pecros: 1. Kendall/0. Vensel L. Kendall/0. Vensel L. Served. J. Served. 3. Head of the pressure was ob- served. American Orilling Co. WATER: American Orilling Co. WATER: American Orilling Co. WATER LEVEL, IM HOLE AFT INDICATE. WATER TOWN RESIDENCE: WEER OF MARGINE TO SERVE 2. HERE SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERE SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERE SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERE SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERES SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERES SOME SAMPLES 12 HERESTANCE: WEER OF MARGINES TO SERVE 2. HERES SOME SAMPLES 12 HERESTANCE:	CLASSIFICATIONS BY: NEYER TISEO & HINDOLTD GROUND SURPACE ELEVATIONS 595.6 FILL: Black SILTY SAND AND GRAVEL with Wood, Mire, Brick, Concrete and Black Foundry Sand. LS-2 LS-3 PS-2 LS-4 LS-5 Soft to Medium Gray SILTY CLAY with Trace of Sand. LS-6 LS-7 Soft to Medium Gray SILTY CLAY with Trace of Sand. LS-8 PS-2 SS-1 LS-6 LS-7 Very Compact Gray SAND AND GRAVEL LS-9 LS-10 LS-11 LS-12 Very Compact Gray SAND AND GRAVEL CS-9 LS-10 LS-11 LS-12 Very Compact Gray SAND AND GRAVEL CS-11 LS-12 Very Compact Gray SAND AND GRAVEL SS-12 LS-13 Very Compact Gray SAND AND GRAVEL SS-13 Very Compact Gray SAND AND GRAVEL SS-14 NOTES: 1. Berings advanced using 4-inch diameter tricone roller bit with recirculating drilling fluid to bottom of hole, 4-inch diameter casing was driven to 12.5 feet. 2. Artesian water pressure was observed after penetrating the same gray and compacting fluid to bottom of hole, 4-inch diameter casing was driven to 12.5 feet. 2. Artesian water pressure was observed after penetrating the same gray and compacting in place of the penetrating the same gray and penetrating the same gray an	CLASSIFICATIONS BY- NEYER TISEO & MINDOLLYD GROUND SUPPACE ELEVATION 595.6 FILL: Black SILTY SAND AND GRAVEL with Wood, Wire, Brick, Concrete and Black Foundry Sand. LS-1 590.6 LS-2 585.6 LS-2 585.6 LS-3 580.6 PS-1 578.1 LS-4 575.6 LS-5 570.6 LS-6 555.6 LS-7 550.6 Soft to Medium Gray SILTY CLAY with Trace of Sand. Soft to Medium Gray SILTY CLAY with Trace of Sand. LS-6 555.6 LS-7 550.6 Soft to Medium Gray SILTY CLAY with Trace of Sand. Soft to Medium Gray SILTY CLAY with Trace of Sand. LS-6 555.6 LS-13 500.6 VS-2 580.8 LS-10 515.6 LS-11 510.6 LS-12 505.6 LS-13 500.6 Very Compact Gray SAND AND GRAVEL Of Soft and 3-7/8 inch diameter tricone roller bit with recirr- culating drilling fluid to bottom of hole. 4-inch diameter casing was driven to 12.5 feet. A fine diameter pressure was ob- served after penetrating the 100. LLS-13 S00.6 NOTES: A served after penetrating the 100. LS-14 495.6 NETTATION RESISTANCE: SON. SANDARD TIL MINDEAU INDICATES LESSI ADMINISTRATION RESISTANCE: SON. SANDARD TIL MINDEAU INDICATES ALLEN PAR FORD ALLEN PAR SON. SANDARD TILL MINDERS. UNION 140 AMPRICATION RESISTANCE: SON. SA	SOFT TO Medius Gray SILTY CLAY with Frace of Sand. Soft to Medius Gray SILTY CLAY With Frace of Sand. Soft to Medius Gray SILTY CLAY Soft t	CLASSIFICATIONS BY: NEYER TISEO & MINDO LTD SAMPLE CLEV MOISTURE CORY CREATED CREA

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		1000	OG OF SUBSURFACE PROFILE	 	\$ C	IL SAM	PLEO	TA
			ASSIFICATIONS BY:			JARUTAK		
		-	NEVER, TISEO & HINDO. LTD.	SAMPLE	ELEV.	MOISTURE	C#4	Benetsation &
	•	GA	OUND SUPPACE ELEVATION	MUM BER	(FEET)	CONTENT	06#8177	PESISTANCE
			591.9			(PERCENT)	(PEP) d	10 20 30 40
	59	0 <u>/ /</u>	FILL: Compact Dark Brown SILTY <> SAND with Siag.	5-1	586.9	18.9	•	3-3-2
	€ <u>A</u>	رز	FILL: Loose to Medium Compact 3.0 Gray SILTY FINE SANO with		C 0 3 A			MILL
	580	11	Little Clay.	F2-1	581.9	•	e 1	4.5.7
				LS-2	576.9	33.1	86.8	2-2-3
	570	11		LS-3	571.9	49		2.2.4
	J/U	111		75-1	566.9			
		1/1			100.3	-		
	222]/i		LS-4	561.9	18.6	111.6	2-1-4
	560			LS-S	556.9	•	• !	2-3-4
			Soft to Medium Gray SILTY CLAY with Trace of Sand.	LS-6	551.9	40	-	2-3-3
	550	W	The state of saints.	LS-7	546.9	•	•	2-1-3
				ne i	647.4	- 11 1	100	
[540.	 1		PS-1	541.4	21.3	108.4	PUSHE 8
ELE VATION-FEET	,			LS-8	536.9	-	•	2-8-4
ğ		$\ f\ $						
3	900-			12-5	531.9		-	
Ę	530			LS-9	526.9	22.8	102.6	2-3-6
				LS-10	521.9	4	•	2-3-4
	520							
			ما احماد	PS-2	516.4	24.6	103 5	PUSHES
		711	Very Hard Gray CLAYEY SILT with					Toolie I
		24.	Some Fine Sand and Gravel (Hardpan)	LS-11	511.9	8.3	138.9	18-28-44
	510*		NOTES: 1. Borings advanced using 6-inch diameter solid-stem augers to 10 feet, and 3-7/8 inch diameter tricone roller bit with recirculating drilling fluid to bottom of hole. 4-inch diameter casing was driven to 12.5 feet. 2. Groundwater was encountered at 8.2 feet during drilling. 3. Boring backfilled with cament grout to surface.					
			. SEPTIC: 80.0° ■ STARTED 12/26/84			j		

CONTING STARTED SORING COMPLETES: 12/27/84

12/26/84

INGPECTOR:

D. Vensel

ORILLER:

J. Blank

American Drilling Co. CONTRACTOR: WATER LEVEL IN HOLE AT INSICATES MANUSER OF HOUSE AFTER COMPLETION OF BESTIME WITH _ O PEET OF CASING IN PLACE.

*PENETRATION RESISTANCE SVIND OF COMMON SWOOD TO COMMON NEYER, TISEO & HINDO, LTD. CONSULTING ENGINEERS LOG OF TEST SORING NUMBER 18-2

> ALLEN PARK CLAY MINE LANDFILL FORD MOTOR COMPANY ALLEN PARK, MICHIGAN

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						TABU	LATIO	NOF	TES	T DA	TA			· · · · · · · · · · · · · · · · · · ·			O-Cinada, popu				· · · · · · · · · · · · · · · · · · ·
		Stranding of the strange of the stra	A					•	MALYSI		Pa	RTICL	Æ Sı	ZE D	ISTRI	BUTI	ON		teroi I mi te		
Test by Number	SAMPLE NUMBER	DEPTH OF SAMPLE TIP	ELEVATION OF SAMPLE TIP	Unconfined Compressive Strength (PSF)	FAILURE STRAIN (PERCENT)	NATURAL WATER CONTENT (PERCENT OF DRY WEIGHT)	IN-PLACE DRY DENSITY (POUNDS PER CUSIC FOOT)	Solibs (PRRCH21)	Liquids (PERCENT)	AIR (PERCENT)	COLLOIDS (PERCENT)	CLAY (PERCENT)	SILT (PERCENT)	FINE SAND (PERCENT)	MEDIUM SAND (PERCENT)	COARSE SAND (PERCENT)	GRAVEL (PERCENT)	LIGUID LIMIT (PERCENT)	PLASTIC LIMIT (PERCENT)	PLASTICITY INDEX (PERCENT)	IPPARENT SPECIFIC GRAVITY
æ																			*	B. ~	<
) a	LS-1 PS-1	5.0	590.6	1440		12.4	101.4			Ì					Westmanne				-		
	LS-5	17.5 25.0	578.1 570.6	1440	18.0	23.9 36.6	105.9								anni ta di di di			24	14	10	
,	PS-2	32.5	563.1	1280	20.0	17.9	84.7)						~		-	
	LS-7	45.0	550.1	_	_	21.1	107.9							dunestatus				25	14	11	
	PS-3	60.5	535.1	1160	20.0	21.7	110.3								-			30	16	14	
	LS-9	75.0	520.6	_	-	25.9	99.7											_	-		
	LS-11	85.0	510.6	_	-	21.7	106.2											۰.	6 95	_	
Taxability (Spinostic States of Stat	LS-13	95.0	500.6	-	_	31.6	88.5										er en		-	_	
1000 mm.	S-1	5.0	586.9	44459	-	18.9	-							,	O chancillo and a second		-	-			
	LS-2	15.0	576.9	4970	_	33.1	86.8					8		**************************************		W-100	POZOCIONAL SERVICIONAL SERVICI		_	-	
	LS-4	30.0	561.9	-	→	18.6	111.6										terrent in the second	-	_	-	
94.00	PS-1	50.5	541.4	1380	20.0	21.3	108.4	(See q	i loano	lation	Tes	Re	iult	i)		The state of the s	town to the same	30	16	14	
A CONTRACTOR	LS-9	65.0	526,9	(74)	1880	22.8	102.6									- Constitution of the Cons	Annocental and the	-	-	-	etinenois-gan

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SAMPLE NUMBER DEPTH OF SAMPLE TIP DEPTH OF SAMPLE	N	N	TEST PIT NUMBER			JE OF
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FAILURE STRAIN (PERCENT) DATA NATURAL WATER CONTENT (PERCENT OF DRY WEIGHT) IN-PLACE DRY DENSITY (POUNDS PER CUBIC POOT) SOLIDS (PERCENT) AIR (PERCENT) COLLOIDS (PERCENT) CLAY (PERCENT) SILT (PERCENT) MEDIUM SAND (PERCENT) MEDIUM SAND (PERCENT) COARSE SAND (PERCENT) GRAVEL (PERCENT) 1 DATA ATTERNATION APPARENT SPECIFIC GRAVITY APPARENT SPECIFIC GRAVITY	9	516.4	ELEVATION OF SAMPLE TO			
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Project Allen Park Clay Mine Landfill Location Allen Park, Michigan

DATE

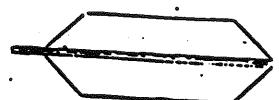
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December 19, 1984

FIELD VANE SREAK TEST REPORT

The M.	VS-1	
MINO ROLE NO.	TB-1	ELEV. TOP OF HOLE 595.6
LUTE & STA.		DEPTH TO TEST POINT 35.0
OFFECT		ELEV. OF TEST POINT 560.6
	*	(210 of Vana)

TORQUE ARM LGTH. 12 IN. YA B B
TORQUE ARM DIA. 374 IN.
VANE LGTH. 5 IN.
VANE DIA. 25 IN.



(Los./Sq. Ft.) 30.87 × Applied Torque (T)

	12 (1	B LOS.)	
The partition	: JUPER GARA	1 6 1 2 3 7 7 7 6 7 7	ONDITION
DOCTOOS)	Kesqine(Ipe)	(Decres)	Randing(Los)
12	29 28 "	20	15.5 5.5 15.5 -
25 30	27:5 28:5	25	15.5
15	27	puntar puras D	ಜ= ೧೯೧೯)
of for Yaze	(£be)	29.0	15.5
er for Shat	<u>e (12) </u>		
Force x for	rque Ara (In	29.0 Lbs) 348.0	15.5
\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\	2	895	478
<u>er (ಇಕಾಗಿಗಳ</u>	(a)	1.87	-
ample PS-2)	Strength 64	aed Comprehe	asive
	CHECTE	BLF	
	Joseph Jo	JUD CIURSED CONDITION ALTAULL STEE VARS JOEFees) Reading(Lbs) 10 28.5 12 28 28 28.5 28 28.5 29 27.5 30 27 28 for Vane (Lbs) Force x forque Arm (Inc. 1) 11 (Xedisturbed) 21 (Xedisturbed) 22 28 28 28 28 28 28 28 28 28 28 28 28 2	OND_TURBED CONDITION RECOLDED C A_URULE

Comments Increase shear strength by 7% to 960 psf based on Bjerrum's connection factor (Ref.1).

Ref 1: Bjerrum, L. "Embankments on Soft Ground", Proceedings of the Specialty Conference on Performance of Earth and Earth Supported Structures ASCE Vol. 2, 1972, on Less

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•	City/Hitchigottats	. m. m. m. l				
Project_	Allen	Park	Clay	Mine	Landfill	
Location	Allen	Park	. Mic	higan		
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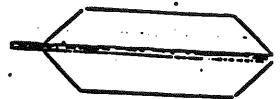
ATE December 20, 1984

PIELD VARE SKEAR TEST REPORT

The 10 .	VS-2	
DOLLE S		ELEV. 10P OF HOLE 595.6
LUTE & STA.		Defre to test form 55.0
OTEN:		ELEV. OF TIST POINT 540.6
	6	(Sis of Yana)

TOROLE ARM LGTH. 12 IN.
TOROLE ARM DIA. 374 IN.
VANE LGTH. 5 IN.
VANE DIA. 2.5 IN.

YARE BAZA



(Les./Sq. Ft.) 30.87 x Applied Torque (T)

	• • • • • • • •		15 (1	LOS.)	
ANCESCION ON A	SO WHEE	UND CTURE	ED CONDITION	RETOLDED C	OIDITION
(Degrees) Rus	eruc(fps)	/jotseos)	Hesqint(Ips)	(Delizade)	Brading(Los)
		<u>lo</u>	<u> </u>	7o	10
		.]5	25	15	1.2
		25 30	32	25	2
				35	2.5
RZADINGS & CAI				CONTINUE CON	Exceloration
Maxisus Force	Gago Reads	Ar for Vale	(Eb)	28.0	12.5
Meximus Force	Gage Road!	es fer Shat	t (Lis)		
Het Porce (Lbs	سيسه مستحده مسموح			28.0	12.5
Applied Torque Ultimate Shear	(T) o Fet	Force x To	Faue Ara (In	(as) 336.0	150.0
	and +8	\3/ 4 \\$	3	864	385
Sensivity a S	1982 Strong	stà (Vedist	urbed) =	2.24	
Natural Vater Content			Strength 580	ed Comprehe	asive
PERMICIAN		LK	Coloron -	<u>, </u>	77.

Comments Increase shear strength by 3% to 890 psf based on Bjerrum's correction factor.

(Ref.1).

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kion Allen Pa	ark, Michigan		ate	December	20. 1984
		PIED VARE	SKLAR TEST RE	, , , , , , , , , , , , , , , , , , ,	
			ELEV. TOP : 0		595.6
DORANG MO	LE 30. TB-1		DEFE TO I	CHICAGO CONTRACTOR	70.0
lunt & st. Office	A			est fort.	SECURITION OF THE PARTY OF THE
				of Vane)	en e
TOROLE ARI	M LGTH. 12 IN.	ELLY	PAIA		
VANE LOTH.	M LGTH. 12 IN. M DIA. 174 IN.		•		
VANE DIA.	25 N.	ADDRESS TO THE PARTY OF THE PAR		•	
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Vikies	ta Shan Shan			7	
Vitica ()	te Shear Street Los./Sq. Ft.)	5th (5) .	30.87 × 10015	od Terque	(T)
		5th (5) -	30.87 × 10012	od Terque	(T)
PRICTION	OH VARE SHARE	שום: מותו	ED CONDITION	REIOLDED	COMPTRICA
PRICTION (midiciums	ED CONDITION	RETOLDED	CONDITION 1
PRICTION (OH VAITE SHAFT	minitura A. taulus (Docteos)	ED CONDITION 30Fce vage Reading(Lbs)	REIOLDED AUGSTICA (Degrees)	CONDITION FORCE VS
PRICTION (OH VAITE SHAFT	ORIDITURE ALTRUSUL Degrees)	ED COMPLTION Sorce Gage Reading(Lbs) 5:0	REIOLDED AUCATION (Degrace)	CONDITION Force va Raeding(
PRICTION (OH VAITE SHAFT	ORD CTURE AL CRUSUL Degrees) 10 20 25	ED COMPLTION Sorce Gage Reading(Lbs) 5.0 12.0 19.0	RECOLUED AUCASTUR (Decreas)	CONDITION SACRET
PRICTION (OH VAITE SHAFT	DID LIVE L CAULUL Degrees) 10 25 25	ED COMPITION FORCE GAGE Reading(Lbs) 5.0 12.0 19.0 18.5	REIOLDED AUCATION (Degrace)	CONDITION Bure Wa Racding(
PRICTION (OH VAITE SHAFT	ORD CTURE AL CRUSUL Degrees) 10 20 25	ED COMPLTION Sorce Gage Reading(Lbs) 5.0 12.0 19.0	RECOLUED AUCASTUR (Decreas)	CONDITION SAME SAME SAME SAME SAME SAME SAME SAME

Applied Torque (T) - Net Force x Torque Ara (In Lbs) 228.0 84.0 Ultimate Shear Strength (3) = -586 216 Sheer Strength (Undinturbed) 2.71 Natural Javer Helf-Unconfined Comprehensive Strength Lbs./Sq. 7%. Content

19.0

7.0

TECHNICIAN . LK CERCICA 8LF

Increase shear strength by 3% to 600 psf, based on Bjerrum's correctional factor (Ref. 1)

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Project No	. <u>84185</u> N	EYER, TISEO & HI	NOO, LTD.	
Project Location	Allen Park Clay Mine Allen Park, Michiga	• • •	December 26.	1984
		- 2	ELEV. TOP OF HOLD DEPTH TO TEST POINT ELEV. OF TEST POINT (Tip of Value) DATA	591.9 25.0 566.9

Vitinate Shear Strength (S) = 30.87 x Applied Torque (T) (Los./Sq. Ft.)

			12	l Lbs.)			
UNDISTURBE	D CONDITION	ייים בדניתם	ED COMPLETION	RICLDED CO	NIDITION .		
(Degrees)	gradiac(fps)	17-cet.e08)	Reading(Los)	(Decress)	Roading(Los		
5		40	33 33	5	8		
· 10 15	<u> </u>	•	34	10			
20	12.5	50 55	32	13			
25 30	38						
	CALCULATIONS			CONDITION	CONDITION		
Hendaus Fo	rce Gage Read!	AR for Vane	(ed1)	34	9		
Mariana Fo	Tee Gege Road!	ng for Shaf	t (Li) e)				
Net Force	سيه فينسه فيسه			34	9		
Applied To Vitinate S	rque (T) - Het bear Strength	Force x To	Foue Arm (In	(bs)_408	108		
	The second secon		2	1.050	278		
Sensivity	Shear Street	sth (Vediat	urbed)	3.78			
Metural Ja Content	ter . 3		Half-Vacuafi: Strength	led Comprehen	nsive 7:.		
PECHICIAN	D.R.V.		(diega)				

Course nts	Increase	shear	strength	by	7%	to	1120	based	on	8jerrum'	\$	correction	factor	
	(Ref.1).					elleria (m. 1900)	all control of the second second		telineligania	•	4995		And the second second	

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NEYER, TISEO & HINDO, LTD. ... Allen Park Clay Mine Landfill Project Allen Park, Michigan Location CATE December 27, 1984 FIELD VANE SHEAR TEST REPORT THE NO. **VS-2** ELEV. TOP OF HOLE 591.9 MORDIO ROLE NO. TB- 2 DEPTH 10 TEST POINT LUIK & STA. 60.0 elev. Of test folds 531.9 OFFICE (Tip of Vane) TORQUE ARM LIGHT. 12 IN.
TORQUE ARM DIA. 174 IN.
VANE LIGHT. 5 IN.
VANE DIA. 25 IN. YARR RARA Witneste Shear Strongth (5) . 30.87 * Applied Turque (T) (In. - Lbs.) (Los./3q. Ft.) PRICTION ON VALLE SHAFT UNDICTURED CONDITION HOTATION RECOLDED CONDITION Songthe (Tos) Reading(Lbs) مل تعاتايات (Degrees) 40 63 51 0 B norce sate Jegrees) (Decrees) Reading(Los) 18

	10 15	***	U	0	
		20-5-	5	11.2	
	20 25	20 19.5	15	11.5	
	30	19.5	20	11.5	
READINGS & CALCULATIONS			COMBIGION	CONDITION	
Maximum Force Gago Read!	As for Yes	e (Lbs)	20.5	11.5	
Meet Force (Lbs)	es for Sha	[t ([h))			
			20.5	11.5	
Applied Torque (T) . Net Ultimate Shear Strongth	Force x T	erque Ara (In	Lbs) 246	138	
		the second secon	633	355	
Sensivity - Shear Street	75h (Vedia)	ica:	1.78		
Natural Jater Content - %			aed Comprehen	stae	
ERCENICIAN D.R.V.		CIDECTO	Lbe./Sq.	£7.	

Comments Increase shear strength by 3% to 650 psf based on Bjerrum's correction factor.

(Ref.1)

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NEYER, TISEO & HINDO, LTD.

CONSOLIDATION TEST

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	ING # TB-2			eple	∮ _P	5-1	.	MPLE (ELEV.	. (TIP)) <u>54</u>	1.4	Онеск	ED SY	<u>8LF</u>			
Sam	ple Dia. <u>2</u>	.50 Inc	hes															
				15a .						**************************************	2-10							
								/ PC	* 1.4	tef	(ca	lcul	ated)					1
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